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ABSTRACTS

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Abbreviations used in the Abstracts for
Titles of Periodicals

Jour. Fac. Agr., Hokkaido Imp. Univ.......	Journal of the Faculty of Agriculture, Hokkaido Imperial University
Jour. Biochem	Journal of Biochemistry
Jour. Fac. Sc., Hokkaido Imp. Univ.	Journal of the Faculty of Science, Hokkaido Imperial University
Jour. Forest. Soc.	Journal of the Forestry Society
Jour. Hokkaido Forest Soc.	Journal of Hokkaido Forest Society
Juzenkwai Z.	Juzenkwai Zassi
Kaibo Z.	Kaibo Zassi
Keijo Jour. Med.	Keijo Journal of Medicine
Keijô Ig.	Keijô Igaku
Kinki Fujinka Gk. Z.	Kinki Fujinkwa Gakkwai Zassi
Kumamoto Igk. Z........	Kumamoto Igakkwai Zassi
Kyôto Ig. Z.	Kyôto Igaku Zassi
Kyûshû Shika Gk. Z.	Kyûshû Shika Gakkwai Zassi
Manshû Igk. Z.	Manshû Igaku Zassi
Mem. Coll. Sci., Kyôto Imp. Univ.	Memoirs of the College of Science, Kyôto Imperial University
Mitt. Med. Akad. Kyôto	Mitteilungen aus der medizinischen Akademie zu Kyôto
Nagasaki Igk. Z.	Nagasaki Igakkwai Zassi
Nihon Biseibuts. Gk. Z.	Nihon Biseibutsu Gakkwai Zassi
Nihon Byôri K.........................	Nihon Byôri Kwai-Si
Nihon Fujinkwa Gk. Z.	Nihon Fujinkwa Gakkwai Zassi
Nihon Shika Igk. Z....	Nihon Shika Igakkwai Zassi
Proc. Imp. Acad.	Proceedings of the Imperial Academy
Okayama Igk. Z.	Okayama Igakkwai Zassi
Osaka Igk. Z.............	Osaka Igakkwai Zassi
Report Hokkaido Agr. Exp. Sta.	Report of the Hokkaido Agricultural Experimental Station
Rept. Saghalien Centr. Exp. Sta.	Report of Saghalien Central Experiment Station
Saito Hô-on Kw. Hak. Ziho	Saito Hô-on Kwai Hakubutsukwan Zihô
Saito Hô-on Kw. Mus. Res. Bull.	Saito Hô-on Kwai Museum Research Bulletin
Sci. Rep. Tôhoku Imp. Univ....	Science Report of Tôhoku Imperial University
Seiikai Z.	Seiikai Zassi
Seishin Shinkei Z.	Seishin Shinkei Zassi
Taiwan Igk. Z.	Taiwan Igakkwai Zassi
Trans. Sapporo Nat. Hist. Soc.	Transactions of the Sapporo Natural History Society

TRANSACTIONS

1. Studies on Japanese Mysidacea

II. Descriptions of Three New Species belonging to Two New Genera, Parastilomysis and Paracanthomysis

By Naoyosi Ii

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(With Text-figures 1–41)

Genus *Parastilomysis* n. gen.

DEFINITION. First, second and fifth pleopods of the male rudimentary, unjointed and of the same form as in the female.

Third pleopod of the male biramous ; endopod an unjointed plate ; exopod 4-jointed and terminated by 2 short setae.

Fourth pleopod of the male biramous ; endopod an unjointed plate ; exopod long and 4-jointed, the third joint armed with a strong spinous seta on the outer distal corner, the fourth joint terminated by 2 long spinous setae.

Antennal scale narrowly lanceolate, setose all round and 2-jointed ; apex rounded.

Mouth parts show no very marked difference from those in other genera of the tribe Mysini.

First thoracic limbs have a small masticatory lobe on the second joint, but not on the third and fourth joints.

Propodite of the third to the eighth thoracic limbs divided into 3 joints.

Female has three pairs of oostegites.

Telson cleft at the apex, cleft furnished with a pair of plumose setae and small spines on each margin, lateral margins armed throughout their length with spines.

Inner uropod with a row of spines along the inner margin.

Type : *Parastilomysis paradoxa* n. sp.

REMARKS. The present genus belongs apparently to the tribe Mysini according to Illig (1930), i. e. II D in his key, and is very closely allied to *Stilomysis* Norman (1892) and *Nanomysis* Tattersall (1921) in the structure of the pleopods of the male.

I have been considerably puzzled as to the number of joints on the exopod of the fourth pleopod of the male in the present genus. In the type species the basal part of the inner terminal seta on the exopod of the fourth pleopod

is thick and swollen as shown in Fig. 12. The thick part is furnished with a tiny spine on the inner distal corner and there can be sometimes seen an obscure transverse line at the distal end of the said part. Therefore, the part gives us the impression that it may be a small joint. If we assume that the thick part is a small joint, the character of the pleopod of the present genus agrees absolutely with that of *Stilomysis*, and if we assume that the part is not a joint, the character approaches to that of *Nanomysis*.

After careful and close examination, however, it is revealed that the thick part is not a joint, but in fact only a swollen base on which the tiny spine grows. Though sometimes there can be seen an obscure transverse line at the distal end of the thick part, there exists no mark to enable one to recognize a joint on the outer margin of the seta. In some species belonging to the genera, *Neomysis*, *Acanthomysis* and *Proneomysis*, it is not a seldom occurrence that the same part of the seta is more or less thickened and provided with a tiny spine, so that it seems that the said thick part is rather a common character of the seta found in these allied genera.

It is a regret for me unable to say anything about the terminal small joint of the fourth pleopod in the genus *Stilomysis* as I could not obtain any specimens of *Stilomysis*. In 1928, Marukawa described *S. camtschatica* from the coast of Kamchatka, but he made no mention about the pleopods of the male in his description. So I think it doubtful whether the species described by him actually belongs to the genus *Stilomysis*.

The present genus agrees with *Stilomysis* in the third pleopod of the male. The descriptions regarding the number of joints on the exopod of the third pleopod of the male in the genus *Stilomysis* are contradictory according to authors in several literatures. Zimmer in both of his papers (1904, 1909) described the pleopod as 4-jointed and in the latter paper he gave a figure of the pleopod with 4-jointed exopod. However, Zimmer (1915) in his key to the genera of the tribe Mysini described the pleopod as 3-jointed, and also Illig (1930) in his key to the Mysidae described it as 3-jointed. Reviewing all the referable literatures, I can only suppose that Zimmer mistook in describing the number of joints, or the number was misprinted in his key and Illig carelessly cited the description of Zimmer's key.

At any rate, the present genus is very closely allied to both *Stilomysis* and *Nanomysis*, especially to the former, in the structure of the pleopods of the male. However, the only striking point of difference between the present and those genera lies in the character of the telson. As far as I am aware no members of the tribe Mysini, except *Kainommatomysis* Tattersall, have a telson cleft and furnished with a pair of plumose setae at its apex.

The form of the telson had been very largely used as an important generic character in the past, until Zimmer (1915) in his revision of the genera of the Mysini attempted to systematize the species of the tribe mainly on the character of the pleopods, so that some genera have been obliged to be characterized not solely by the shape of the telson, but rather by laying a greater generic importance on other characters. Tattersall (1927), however, in his remarks on

Kainommatomysis, says "the telson is more Leptomysini than Mysini in character. No member of the Mysini, as far as I can remember, has a pair of plumose setae at the apex of the telson. This feature, on the other hand, is characteristic of the Erythropini and of the Leptomysini." And I think the character of the telson in the present genus is also sufficient to warrant generic independence. Thus, here I separate the present genus from *Stilomysis* and *Nanomysis* mainly on the character of the telson.

Kainommatomysis is clearly distinguishable from the present genus in having the corneal lens and the third pleopod of the male rudimentary and of the same form as in the female.

The present genus is also distinguishable from *Nanomysis* by the absence of the masticatory lobes on the third and fourth joints of the endopod of the first thoracic limbs, by the number of joints of propodite of the third to the eighth thoracic limbs and of the oostegites and particularly by the characters of the telson and inner uropod.

Parastilomysis paradoxa n. sp.

Figures 1–14.

LOCALITIES. Off Hukuoka, Tusima Straits.

Type specimen. Abundant adult males and females (presented by Mr. K. Tuzinaga).

Misaki, Kanagawa Prefecture. About 20 adult specimens of both sexes.

DESCRIPTION. Front margin of the carapace produced into a short obtusely rounded rostral plate. Below the rostrum is a prominent pseudo-rostral process, triangular and acute in both dorsal and lateral views. Antero-lateral corners of the carapace rounded.

Eyes large, about as long as broad in dorsal view and somewhat flattened in lateral view; cornea occupying half of the eye in dorsal view; stalk with a tiny blunt spiniform process on the inner dorsal surface.

Antennular peduncle in the male with the first joint about as long as the third; male sexual appendage well developed and about as long as the third joint. In the female the first joint of the antennular peduncle almost as long as the 2 distal joints combined.

Antennal scale $7^1/_2$ times as long as broad, apex rounded, 2-jointed, distal joint about $^1/_{14}$ of the entire length of the scale, the scale extends for about $^2/_5$ of its length beyond the antennular peduncle. Basal joint, from which the scale arises, with a prominent spine on the outer distal corner.

Front margin of the labrum without spinous process but produced into a short triangular process with rounded apex in ventral view.

Other members of the mouth parts show no very marked difference from those in other genera of the tribe.

First thoracic limbs have a small masticatory lobe on the second joint, but not on the third and fourth joints.
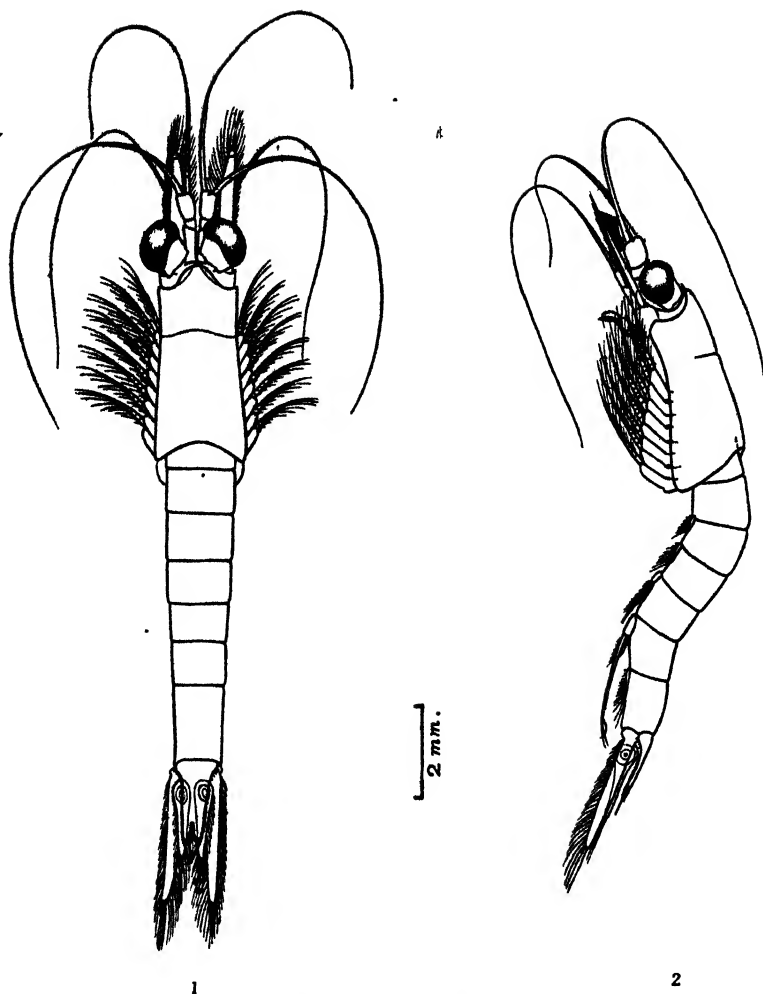
Figs. 1–2. *Parastilomysis paradoxa*, n g. n. sp.

Fig. 1.   Dorsal view of adult female.
Fig. 2.   Lateral view of adult male.

Third to the eighth thoracic limbs with propodite divided into 3 joints. Basal plate of the exopod of all thoracic limbs with a small spine on the outer distal corner, but in the last thoracic limbs the spine is always very obscure.

Sixth abdominal somite about $1^3/_4$ times as long as the fifth.

Third pleopod of the male biramous, endopod unjointed plate; exopod about twice as long as the endopod, extending to the first one-third point of the fifth abdominal somite, 4-jointed, the first joint slightly shorter than the half of the exopod, the second joint about $^1/_4$ of the first, the third joint about $1^1/_2$
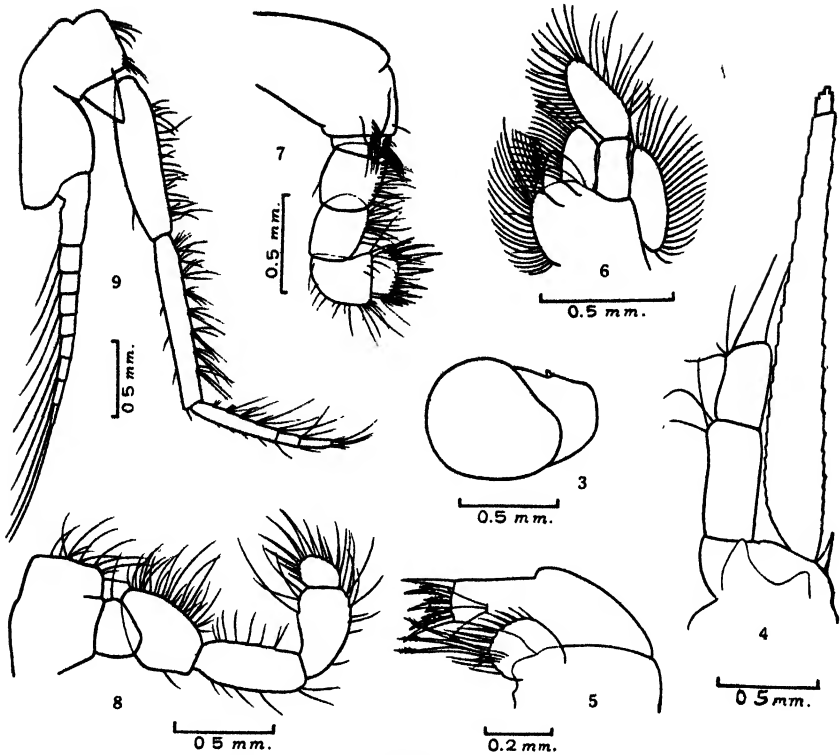
Figs. 3-9. *Parastilomysis paradoxa*, n. g. n. sp.

Fig. 3. Eye, lateral view to show the spiniform process on the stalk.
Fig. 4. Antennal scale and peduncle.
Fig. 5. First maxilla.
Fig. 6. Second maxilla.
Fig. 7. Endopod of the first thoracic limb.
Fig. 8. Endopod of the second thoracic limb.
Fig. 9. One of the posterior thoracic limbs.

times as long as the second, the fourth joint about half as long as the third and terminated by 2 very short setae.

Fourth pleopod of the male biramous; endopod unjointed plate; exopod long, extending backwards to the statocyst, 4-jointed, the first joint slightly longer than the half of the exopod, the second joint about $^1/_4$ of the first, the third joint about $1^1/_3$ times as long as the second and with a single strong spinous seta on the distal outer corner, the fourth joint about $^1/_3$ of the third and terminated by 2 strong spinous setae, which are about 4 times as long as the joint and about as long as the seta on the third joint.

Telson about $1^1/_6$ times as long as the sixth abdominal somite and about $1^2/_3$ times as long as broad at the base, cleft for about $^1/_6$ of its length; the cleft triangular, rounded at the apex, armed with a pair of plumose setae which are slightly longer than twice of the length of the cleft, and with about 12 spines
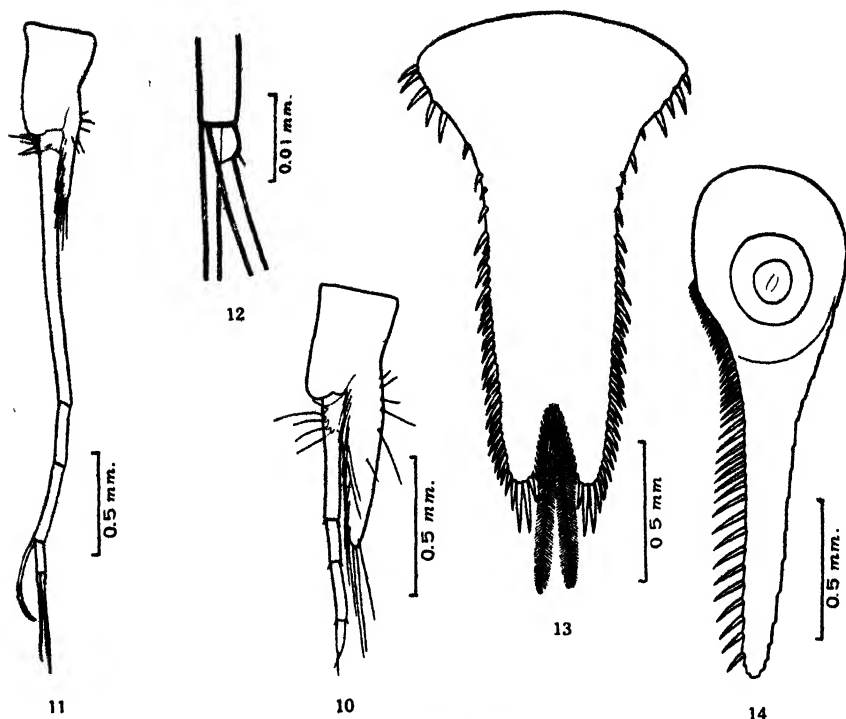
Figs. 10–14. *Parastilomysis paradoxa*, n. g. n. sp.

Fig. 10. Third pleopod of the male.
Fig. 11. Fourth pleopod of the male.
Fig. 12. Distal part of the exopod of the fourth pleopod of the male to show
       the basal part of the inner terminal seta.
Fig. 13. Telson.   Fig. 14. Inner uropod.

on each margin; lateral margins armed with 35–40 subequal spines extending throughout their entire length, the proximal spines more distantly placed than the distal ones; terminal lobes with the apex rounded, almost truncate, and armed with four spines, the inner pair of which are subequal, longer than the outer ones and about $^1/_{10}$ of the length of the telson, the outer ones are about as long as the lateral spines.

Inner uropod about $1^1/_3$ times as long as the telson, the inner margin armed with a row of about 50 spines extending from the statocyst to the apex, the spines gradually widely spaced and increase in size to the apex, reach the greatest size at the second one-third point from the statocyst and then slightly decrease in size toward the apex. Statocyst large.

Outer uropod slightly shorter than twice of the length of the telson.

Length. Adult males and females, 15 mm.

REMARKS. This species is very closely allied to *Stilomysis grandis* (Goës), but clearly distinguishable from it by the much different character of telson, and also slightly differs in the structure of the fourth pleopod of the male.

Genus *Paracanthomysis* n. gen.

DEFINITION. First, second, third and fifth pleopods of the male rudimentary, unjointed and of the same form as in the female.

Fourth pleopod of the male biramous; endopod short, unjointed and with a well developed side lobe; exopod long, unjointed and terminated by 2 strong spinous setae.

Antennal scale narrowly lanceolate, 2-jointed and setose all round; apex rounded.

Mouth parts, first and second thoracic limbs show no very marked difference from those in the genus *Neomysis*.

Propodite of the third to the eighth thoracic limbs many-jointed (about 5-8).

Telson is entire and not split.

Type: *Paracanthomysis hispida* n. sp.

REMARKS. The present genus belongs to the tribe Mysini and apparently to Illig's (1930) group III, A, 2). It agrees with *Limnomysis* Czerniawsky (1882), *Indomysis* Tattersall (1914) and *Idiomysis* Tattersall (1922) equally in having the fourth pleopod of the male with the exopod unjointed, but differs from all of them in having the exopod terminated by 2 strong spinous setae.

The present genus is also very closely allied to *Acanthomysis*, which genus has been separated by the present author (1936) from Zimmer's (1915) comprehensive genus *Neomysis*. The only difference between the present genus and *Acanthomysis* lies in the character of the fourth pleopod of the male.

Paracanthomysis hispida n. sp.

Figures 15-28.

LOCALITIES. Misaki, Kanagawa Prefecture. Common in the growth of sea-weeds in the environs of the Misaki Marine Biological Station.

Type specimen. Abundant, adult males and females.

Port Huzan, Tyôsen (Korea). Abundant, adult males and females.

Ooma, Aomori Prefecture. Abundant, immature males and females. Length, 8 mm.

DESCRIPTION. Body bright vermillion in life.

Carapace leaving the last thoracic somite exposed dorsally, hispid with dense minute spines; front margin of the carapace produced into a short triangular rostral plate with sharply pointed apex; antero-lateral corners of the carapace produced into acute spines.

Eyes, including the stalk, about $1^1/_2$ times as long as broad; cornea occupying about $^1/_3$ of the entire eye in dorsal view.

Antennular peduncle in the female slender and about $^1/_3$ of the length of the carapace. In the male the antennular peduncle is considerably stouter and longer than in the female and about half as long as the carapace; the third
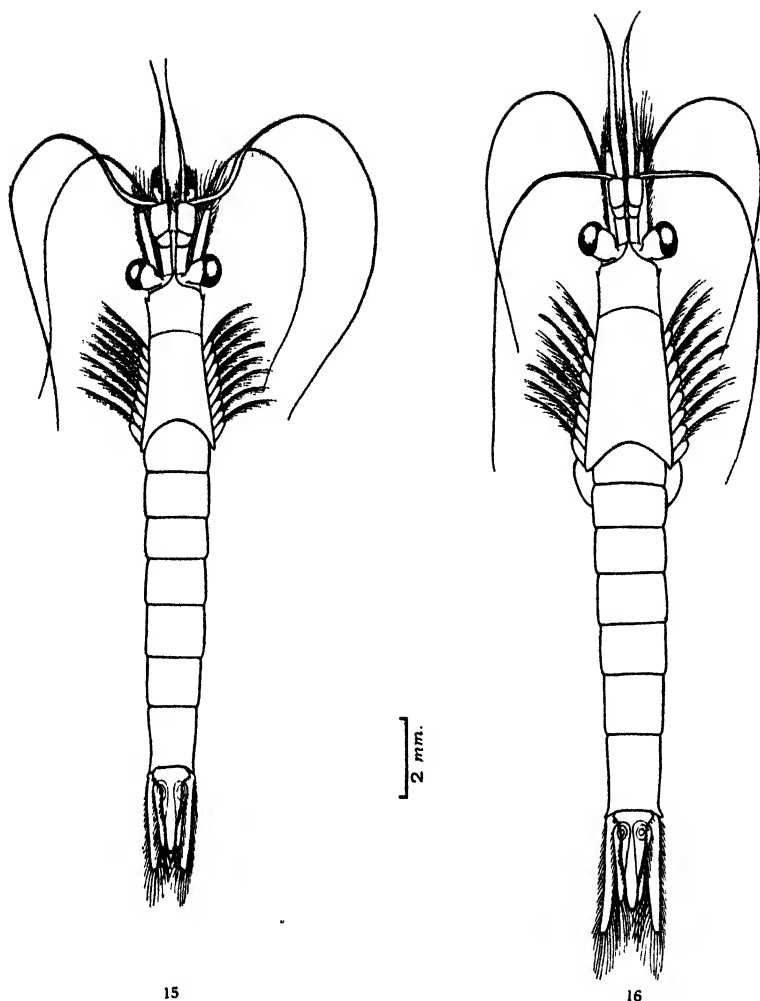
Figs. 15–16. *Paracanthomysis hispida*, n. g. n. sp.

Fig. 15. Dorsal view of adult male showing the unique form of the outer flagellum
of the antennule.

Fig. 16. Dorsal view of adult female showing the unique form of the inner
flagellum of the antennule.

joint almost as long as the first and provided with a dense group of about
20 spines on its inner distal corner, the second joint also provided with a
spine on its inner distal corner; male sexual appendage about half as long
as the third joint.

In the male the outer flagellum of the antennule very stout, about twice
as broad as the inner and curved like a cattle horn in the proximal part;
inner flagellum normal. In the female the inner flagellum of the antennule
characteristically shaped, narrowly lanceolate in shape, about thrice as broad
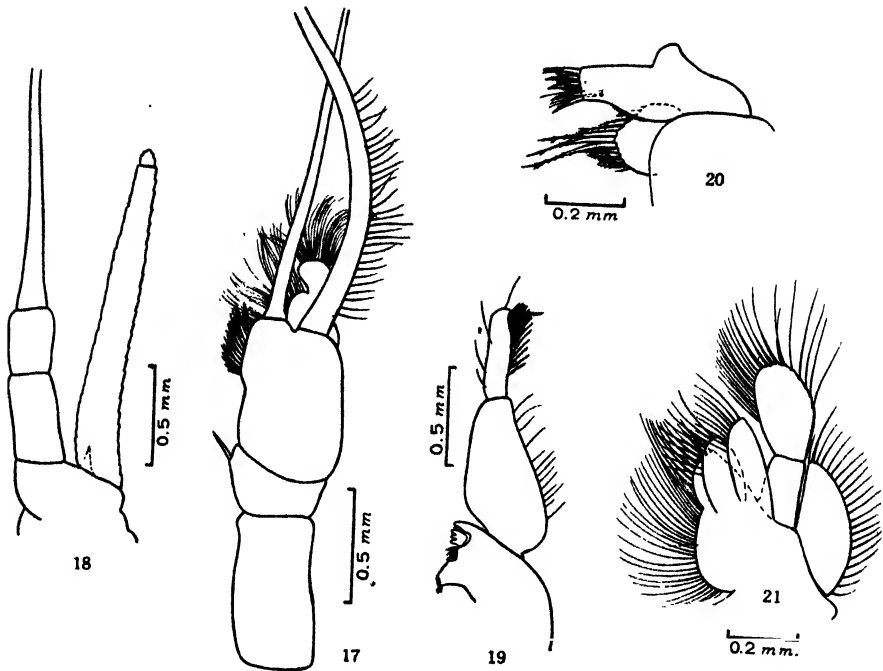
Figs. 17–21. *Paracanthomysis hispida,* n. g. n. sp.

Fig. 17. Antennule of the male, dorsal view to show the spines on the second
  and third joints.

Fig. 18. Antennal scale and peduncle.

Fig. 19. Mandible and palp.

Fig. 20. First maxilla.   Fig. 21. Second maxilla.

as the outer and slightly longer than twice of the length of the peduncle;
outer flagellum normal.

Antennal scale about 10 times as long as broad, 2-jointed, distal joint
about $1/18$ of the entire length of the scale; basal joint, from which the scale
arises, with a spine on the outer distal corner. The scale in the male slightly
shorter than the antennular peduncle, but in the female extending beyond the
antennular peduncle for about $1/3$ of its length.

Antennal peduncle about half as long as the scale.

Mouth parts, first and second thoracic limbs show no very marked dif-
ference from those in the genus *Neomysis*.

Third to the eighth thoracic limbs with · propodite divided into 5 joints.
The fifth joint of the propodite armed with 2 peculiarly armed setae on each
side of the dactylopodite.

The last thoracic somite and each of the 5 anterior abdominal somites
armed with 2 broad transverse band of dense minute spines. The sixth
abdominal somite slightly longer than the fifth, and hispid with dense minute
spines almost all over the surface.
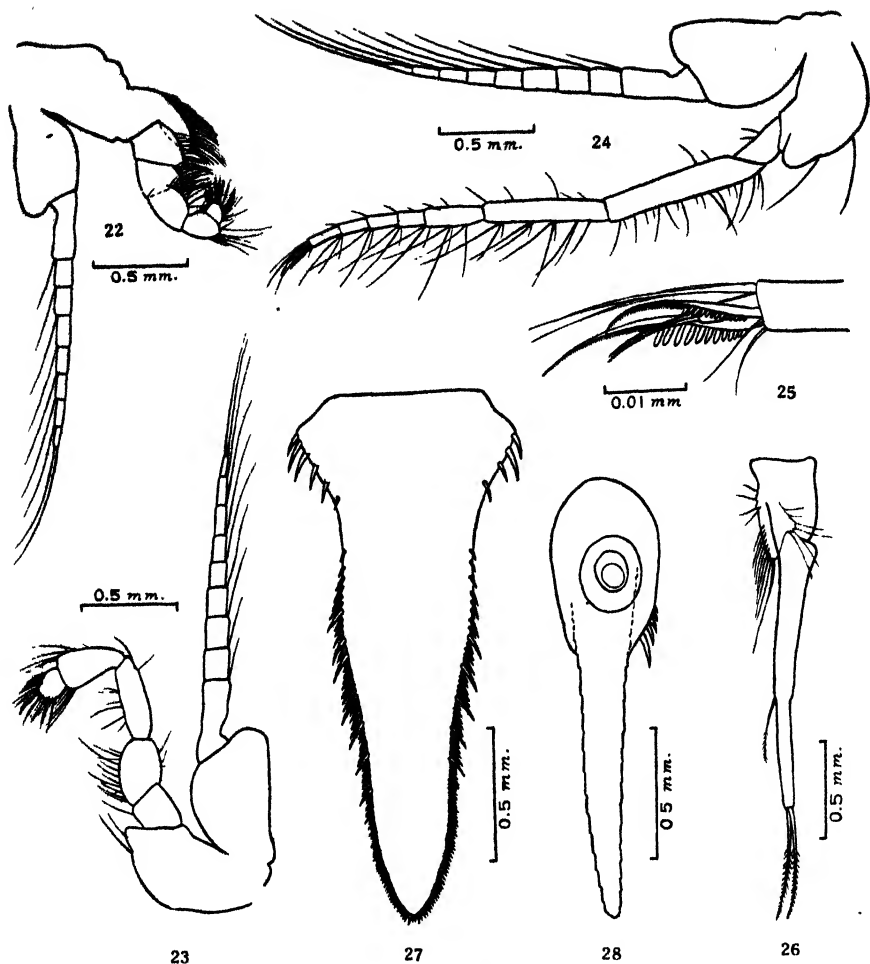
Figs. 22-28. *Paracanthomysis hispida*, n. g. n. sp.

Fig. 22. First thoracic limb.
Fig. 23. Second thoracic limb.
Fig. 24. One of the posterior thoracic limbs.
Fig. 25. Distal end of the endopod of one of the posterior thoracic limbs.
Fig. 26. Fourth pleopod of the male.
Fig. 27. Telson.   Fig. 28. Inner uropod.

Fourth pleopod of the male biramous; basal joint short; endopod short and with well developed side lobe; exopod long, very stout, extending to the posterior end of the last abdominal somite, unjointed and terminating into 2 strong spinous setae which are about $^3/_7$ of the length of the exopod. Proximal part of the exopod broadened and the outer proximal corner raised into a keel. The exopod slightly swollen and armed with 1–2 plumose setae on the inner margin at $^4/_7$ point from the base and gives the impression that there

is a joint, but there can be observable no chitinous transverse demarcation.

Telson linguiform, about $1^2/_3$ times as long as the last abdominal somite and about $2^1/_3$ times as long as broad at the base; lateral margins abruptly narrowing and concave in the first $^1/_3$ part, slightly convex in the second $^1/_3$ part and then gradually narrowing towards a bluntly rounded apex; the lateral spines near the base stout and rather widely spaced, about the middle of the margins the spines are grouped into about 8 series, each series composed of a large spine followed with 2–7 small ones, in the last $^1/_4$ of the margins the spines are short, very closely set and of even size, appearing like a row of closely set teeth rather than articulated spines; the apex armed with 2 pairs of spines, the outer pair slightly longer than the neighbouring lateral spines, the inner pair slightly shorter than the outer.

Inner uropod slightly shorter than the telson, the ventral inner margin armed with about 5 spines near the statocyst.

Outer uropod about $1^1/_3$ times as long as the telson.

Length. Adult males and females, 18 mm.

REMARKS. The present species shows many points of resemblance to those of the genus *Acanthomysis*, but differs from them in the character of the fourth pleopod of the male. The unique form of the outer flagellum of the antennule in the male and the inner flagellum of the same in the female are quite characteristic for the present species and unlike any other Mysids hitherto known.

Paracanthomysis kurilensis n. sp.

Figures 29–41.

LOCALITY. Suribati Bay, the Island of Horomusiro, Tisima (Kurile) Islands. Type specimen. 2 males, 30 females.

DESCRIPTION. Carapace leaving the last thoracic somite exposed dorsally; front margin of the carapace produced into a short triangular rostral plate with rounded apex; antero-lateral corners of the carapace rounded.

Eyes, including the stalk, $1^1/_2$ times as long as broad; cornea occupying about $^2/_5$ of the whole eye in dorsal view; stalk stout, hispid with short hairs and provided with a tiny spiniform process on the inner dorsal surface.

Antennular peduncle in the female rather slender, about $^1/_4$ of the length of the carapace and shorter than the antennal scale, the third joint shorter than the first and provided with about 4 long plumose setae on the inner distal corner. In the male the antennular peduncle considerably stouter and longer than in the female, about $^1/_3$ of the length of the carapace and slightly longer than the antennal scale; the first joint shorter than the third.

Antennal scale about $6^1/_2$ times as long as broad, 2-jointed; distal joint about $^1/_{16}$ of the length of the scale; basal joint, from which the scale arises, with a spine on the outer distal corner.

Antennal peduncle in the female about half as long as the scale. In the

2 m m.

30

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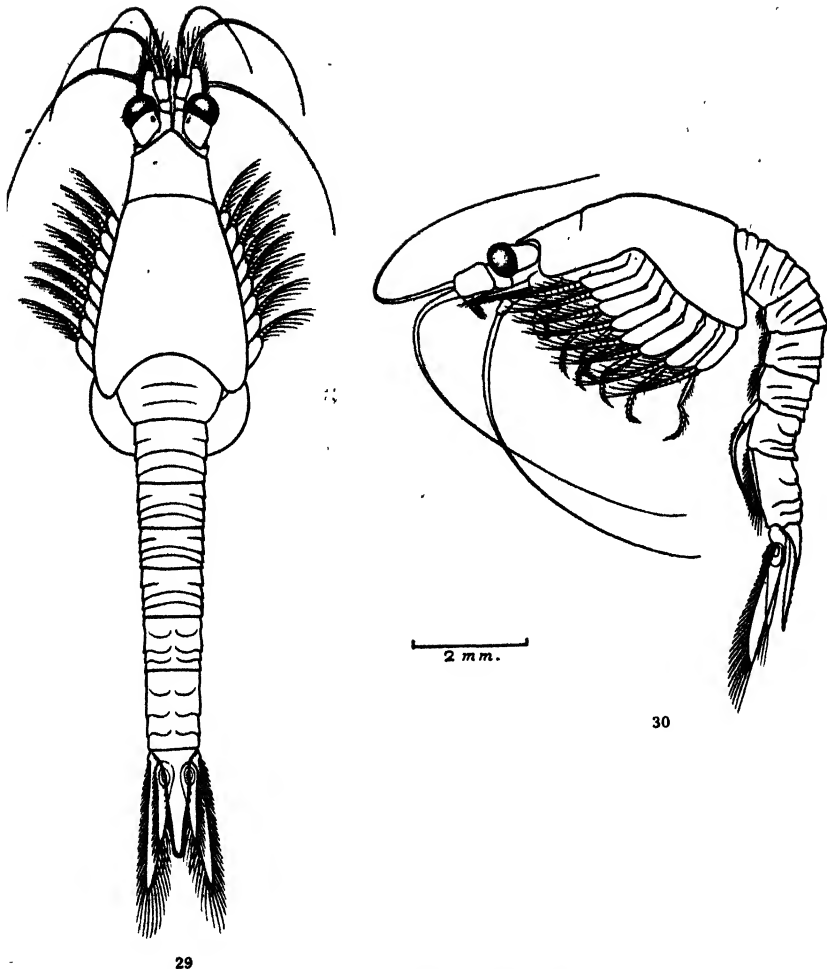
Figs. 29–30. *Paracanthomysis kurilensis*, n. sp.

Fig. 29. Dorsal view of adult female.
Fig. 30. Lateral view of adult male.

male the antennal penduncle stouter and longer than in the female.

Flagella of both the antennule and the antenna in the female shorter than those in the male.

Mouth parts, first and second thoracic limbs show no very marked difference from those in the genus *Neomysis*.

Third to the eighth thoracic limbs slender; propodite of the third and fourth limbs is 8-jointed, and that of the fifth to the eighth limbs 7-jointed; meropodite strong and longer than carpopodite. Basal plate of exopod of all thoracic limbs provided with a tiny spine on the outer distal corner.

The last thoracic somite and the somites of the abdomen with transverse
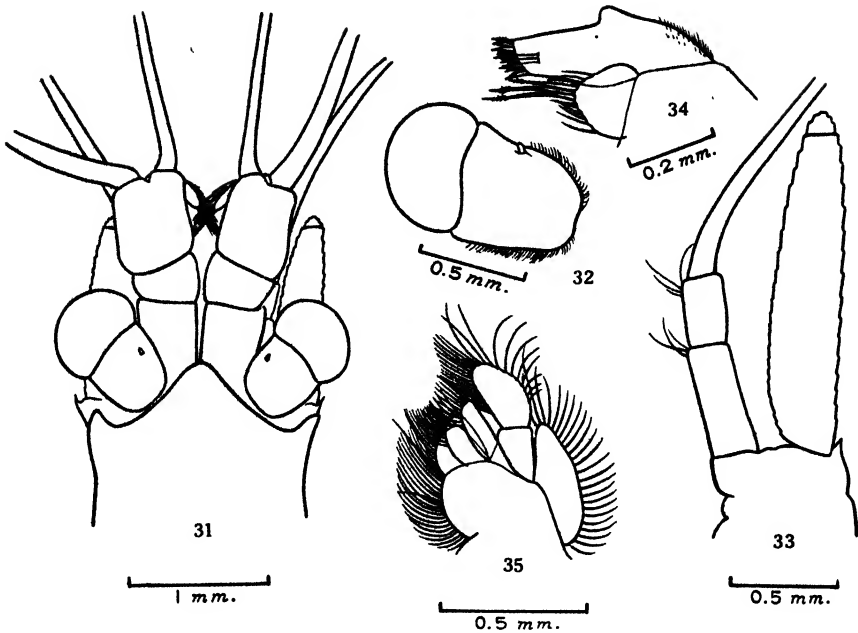
Figs. 31–35. *Paracanthomysis kurilensis*, n. sp.

Fig. 31. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.

Fig. 32. Left eye, dorsal view to show the spiniform process on the stalk.

Fig. 33. Antennal scale and peduncle.

Fig. 34. First maxilla.   Fig. 35. Second maxilla.

folds of chitinous integument which give the impression that each somite is sub-divided into subsidiary somites. The last thoracic somite with 2 and each of all abdominal somites with 3 such folds. In the 4 anterior abdominal somites the foremost fold is widely broken off on the dorsal surface and divided into a pair of folds developed only on lateral sides. In the fifth and sixth abdominal somites each of the folds or the posterior margins of each subsidiary somite narrowly broken off at the mid-dorsal line and slightly produced into a pair of short broad plate overhanging the next subsidiary somites on each side. The sixth somite $1^1/_2$ times as long as the fifth.

Fourth pleopod of the male biramous; basal joint short and broad; endopod short and with well developed side lobe; exopod long, extending to the posterior end of the last abdominal somite, unjointed and terminated by 2 strong spinous setae; about $^3/_4$ point from the base the exopod armed with a plumose seta on the inner margin and the point appears very like a joint, but there can be seen no chitinous division.

Telson long triangular, about twice as long as the last abdominal somite and about thrice as long as broad at the base; apex narrowly rounded; lateral margins armed throughout their whole length by many slender spines, the
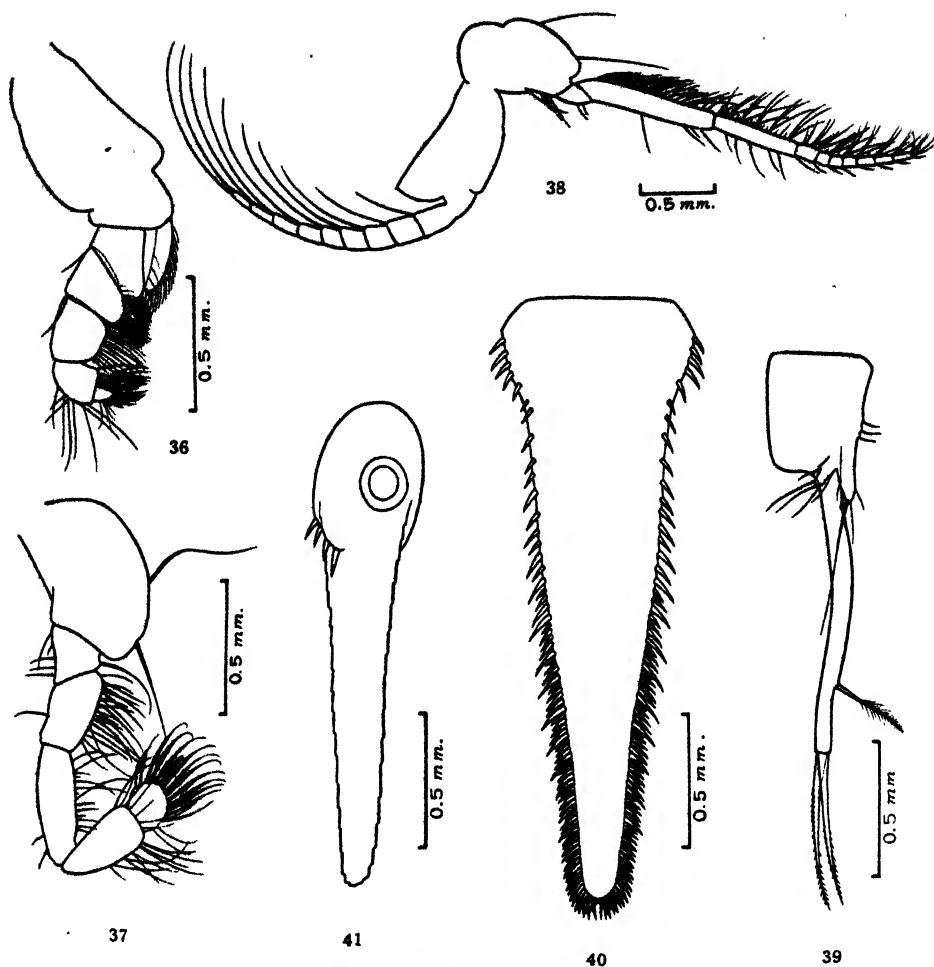
Figs. 36-41. *Paracanthomysis kurilensis*, n. sp.

Fig. 36. Endopod of the first thoracic limb.
Fig. 37. Endopod of the second thoracic limb.
Fig. 38. One of the posterior thoracic limbs.
Fig. 39. Fourth pleopod of the male.
Fig. 40. Telson.
Fig. 41. Inner uropod.

proximal $^1/_3$ of the margins with the spines rather widely spaced, the remaining part of the margins with the spines grouped into 10-12 series, each series composed of a large spine followed by smaller ones; the smaller spines gradually grow longer posteriorly and the groups of the smaller spines varying in number 1-2 proximally to 5-6 in the distal groups; the larger spines decreasing in size posteriorly toward the apex and near the apex they become almost as long as the smaller spines; the apex armed with a pair of extra small spines in the narrow gap between the last pair of lateral spines.

Inner uropod slightly shorter than the telson and with 4-5 spines on the ventral inner margin near the statocyst.

Outer uropod $^1/_5$ longer than the telson.

Length. Adult males and females, 13 mm.

REMARKS. I have been somewhat puzzled as to the systematic position of the present species, for my material contains only 2 adult male specimens with more or less damaged fourth pleopod. In all samples the exopods of the fourth pleopod have been more or less abnormally bent at a short distance from the base. The bent part looks very like a joint. However, after close examination I have reached the conclusion that the part is not a joint on the following grounds that (1) there can be observable no chitinous transverse division on that part and (2), moreover, the relative situation of the part differs, though slightly, in each sample.

In other respects the present species very closely agrees with the character of the genus *Paracanthomysis*, which I have established for the species, *P. hispida* n. sp., and I am sure of the correctness of identifying the present species as belonging to the genus. I hope that male specimens with perfect fourth pleopod will be found some day, and the correctness of the identification may be further demonstrated.

The present species is distinguishable from *P. hispida* by the flagella of the antennule, the armature of the telson and the presence of the folds on the abdominal somites.

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2. A New Polyclad Turbellarian, Cryptocelis amakusaensis, from Southern Japan

By Kojiro KATO

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(With 3 Text-figs. and Plate I)

Through the kindness of Mr. Kikutaro Baba of the Amakusa Marine Biological Laboratory, I had occasion to study a polyclad turbellarian which, according to Professor Ohshima (1928, '32), is fairly common on the sandy beach in the vicinity of the Laboratory during spring and summer, and often attacks the living periwinkle, *Umbonium moniliferum* to put to death.

This acotylean polyclad is undoubtedly a member of the genus *Cryptocelis*, under which have been recorded four species, *C. alba, compacta, glandulata* and *ijimai*. Though presenting some affinity to *alba* the present planarian is widely different from this and other species on some peculiarities of the male genital organs. It represents without doubt a species new to science, for which I give the name *Cryptocelis amakusaensis*.

The body is thick, elongated oval in shape, of about 25 mm long, with broadly rounded two ends. The measurements of a specimen are as follows:

Total length	27 mm
Total breadth	15 mm
Tentacular eye-spots from the anterior end	6 mm, 2 mm apart
Mouth opening from the posterior end	10 mm
Male genital pore from the posterior end	4.3 mm
Female genital pore from the male	1.1 mm
Thickness along the median line	3 mm

In the living state, the dorsal side is uniformly light brown without any color markings and the ventral surface is paler. No trace of tentacles is demonstrated at all, but the tentacular eye-spots, amounting to 13–15 in number, occur in two clusters fairly behind the level of the brain. Numerous cerebral eye-spots are present in two indistinct groups on either side of the median line, chiefly in front of the level of the tentacular eye-spots. Marginal eye-spots are distributed in rows along the whole dorsal margin, being denser in distribution toward the anterior body end than the posterior. As all these eye-spots are extremely small in size and embedded deeply in the parenchyma, they are visible hardly in the living state but only in the clarified specimen.

The epidermis is about 60 μ in height, composed of columnar cells which contain numerous spindle shaped, eosinophilous rhabdites and much basophilous secretion, the latter is conveyed from the mucous gland cells embedded in the dorsal and ventral parenchyma. These secretions make a layer over the whole body surface being emptied from the epithelial cells when the animal has
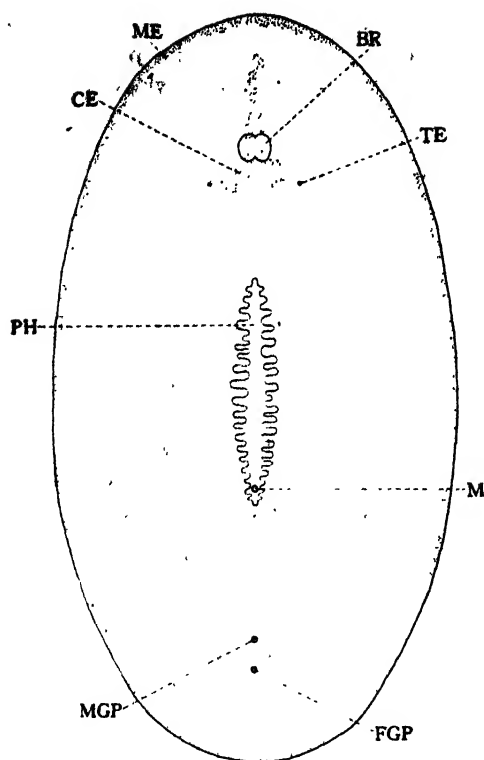
Fig. 1. *Cryptocelis amakusaensis* sp. nov., ×3.5. BR brain, CE cerebral eye-spots, FGP female genital pore, M mouth, ME marginal eye-spots, MGP male genital pore, PH pharynx, TE tentacular eye-spots.

Fig. 2. Tentacular eye-spots of *Cryptocelis amakusaensis*. ×35.

been preserved. Such an abundance of secretion may make the animal more easily move in and on the sand while it lives. Subcutaneous gland is lacking in this species. Underlying the epidermis is a thin basement membrane and beneath it is found a well developed dermal musculature which is slightly powerful on the ventral side than on the dorsal. The musculature is made up of three main layers. The outer is longitudinal. The middle is diagonal and is separated again into two layers, between these occurs a thin transverse layer on the ventral side alone. The inner is transverse layer on the dorsal side and longitudinal on the ventral. In addition to these layers, a thin transverse layer is present immediately beneath the basement membrane. Dorsoventral muscle fibres are also fairly well developed.

The mouth lies at about the hind end of the middle third of the body and leads into the pharyngeal chamber near its posterior extremity. The plicated pharynx extends up to about the middle third of the body length. The main trunk of the intestine gives off numerous lateral intestinal branches which do not show any anastomosis.

Numerous testicular follicles occur in the ventral part of the body. The seminal canal with a distinct muscular wall is much coiled and filled up with a great mass of spermatozoa throughout its length. It proceeds backward on either side of the body from the level of the anterior end of the pharynx. Skirting the latter it gradually increases its diameter to reach slightly behind the end of the pharynx. Here, the seminal canal is highly distended with a mass of spermatozoa and forms a false seminal vesicle. Issuing from this seminal vesicle a narrow duct enters the proximal part of a characteristic, enormous prostate gland near on each lateral end, piercing its thick muscular

envelope. Therefore in this species as in *ijimai* the seminal canals do not form the unpaired common duct. The characteristic features of the prostate gland in the genus *Cryptocelis* were discussed in detail by Bock, whose conclusion upon it is cited here: " If we summarize what has been said, we find that in *Cryptocelis Ijimai* there thus occurs a large muscular organ. Inside this muscular sac there is a proximal part with typical prostatic glands and a distal part, developed as a narrow spiral duct, containing numerous subepithelial
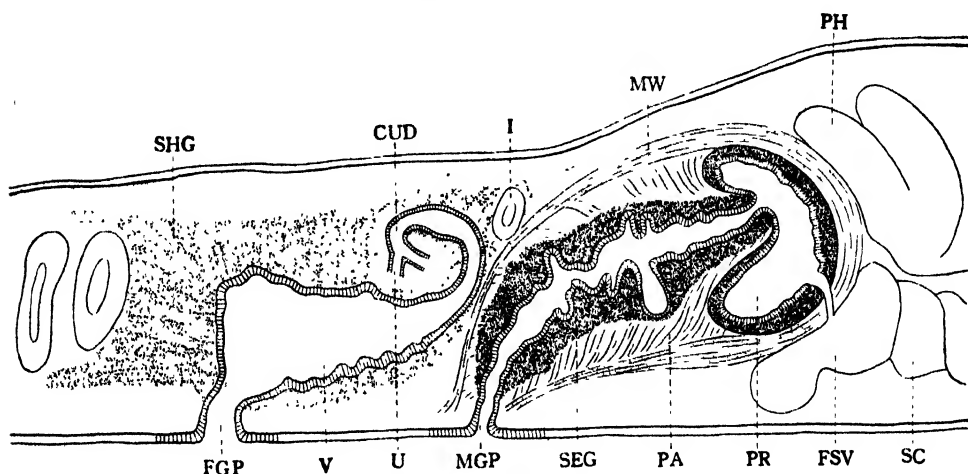
Fig. 3. Genital organs of *Cryptocelis amakusaensis* in longitudinal section, diagrammatic. ×30. CUD common uterine duct, FGP female genital pore, FSV false seminal vesicle, I intestine, MGP male genital pore, MW muscle wall, PA parenchyma, PH pharynx, PR prostate gland, SC seminal canal, SEG subepithelial gland, SHG shell gland, U uterus, V vagina.

glandular cells transmitting a secretion which is more finely granular and also, though eosinophile, not so strongly stainable." In *amakusaensis*, the proximal part is a great concavo-convex body lined with folded cylindrical gland cells, surrounded with an abundance of subepithelial gland cells which secrete coarsely granular, eosinophilous secretion into the cavity, in which are also observed a mass of spermatozoa. The distal part of the prostate is a tubular duct which is issued from the center of the proximal concavo-convex body. The wall of the canal consists of an inner layer of epithelium and an outer enormous layer of subepithelial gland cells which empty finely granular eosinophilous secretion into the duct. The wall of the duct is numerously folded and is provided with a large sac on the ventral side, in which was observed a mass of secretions. Between this glandular layer and the outer muscular envelope as mentioned above, is present the parenchyma, through which pierce numerous coarse muscle fibres and the efferent ducts of the extracapsular glands. The distal part of the prostate passes into a narrow antrum masculinum to open outside without forming the penis.

 The female genital pore lies slightly behind the male pore and leads directly into a capacious, laterally compressed vagina which narrows gradually

to run forward and near the male genital organs curves upward and instantly runs backward for a short distance and turns again sharply to ventral side to continue, as pointed out by Bock, into the common uterine duct which soon divides into two uteri. The vagina is lined with highly cylindrical epithelium and is coated with a very thin musculature. Surrounding the whole length of vagina is developed the shell gland, the secretion of which is minutely granular in nature and highly eosinophilous. Each uterus lined with a high ciliated epithelium, runs forward close along the pharynx to near its anterior end but does not join with each other. The ovaries lie in the dorsal side of the body. In this species was observed no postgenital vesicle which is characteristic in *ijimai*.

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EXPLANATION OF PLATE I

Fig. 1. *Cryptocelis amakusaensis* sp. nov. ×1. (The posterior part warps owing to the fixation)
Fig. 2. Transverse section at about the middle of the body. ×12.
Fig. 3–5. Longitudinal sections through the genital organs. ×26.
Fig. 6. Part of a tangential section through the pharynx. ×6.

ABBREVIATIONS IN PLATE I

CUD common uterine duct, DM dermal musculature, EP epidermis, FSV false seminal vesicle, I intestine, MI main intestine, MW muscle wall, OV ovary, PA parenchyma, PH pharynx, PR prostate gland, SC seminal canal, SEG subepithelial gland, SHG shell gland, SP sperm, TS testis, U uterus, V vagina, ♂ male genital pore, ♀ female genital pore.
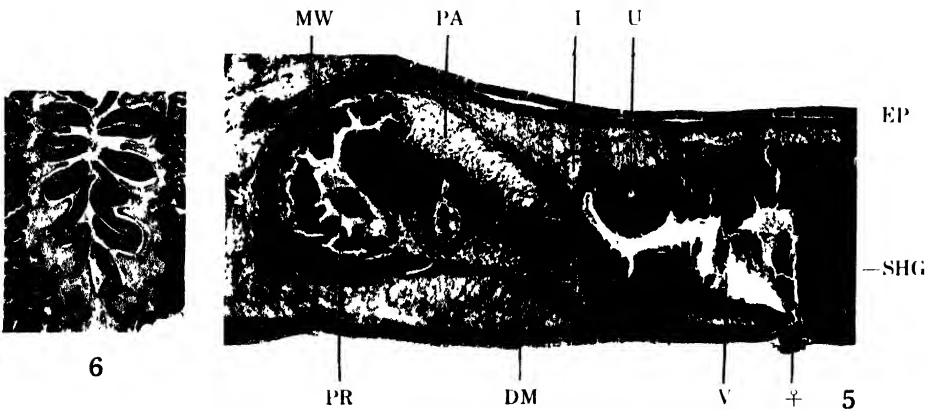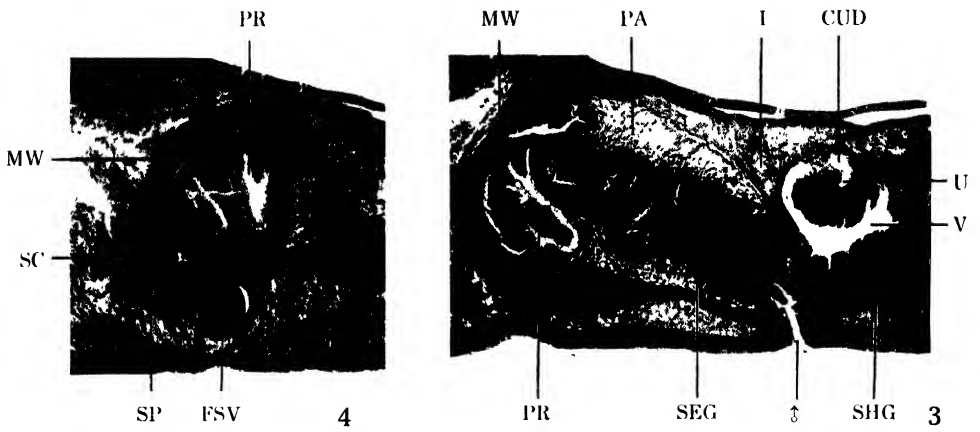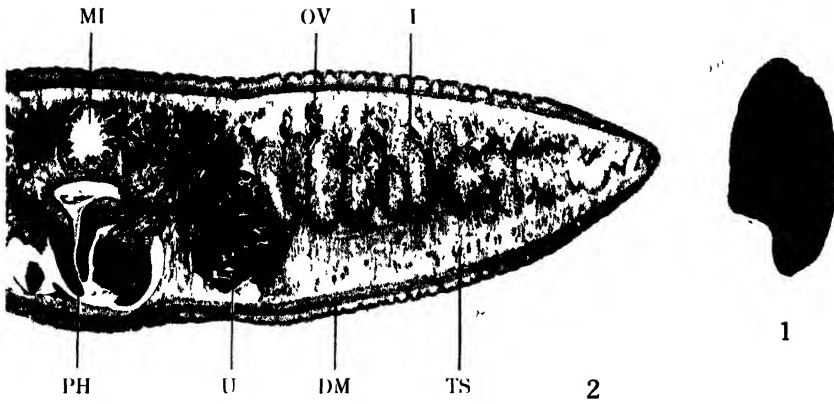
3. Notes on Paraplanocera

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(With 5 Text-figs.)

The genus *Paraplanocera* was erected by Laidlaw in 1903 for such Plano-cerids as provided with a pair of seminal vesicles and a bursa copulatrix. After a thorough revision of the Planoceridae as well as of other polyclads, Bock gives the following diagnosis of the genus: "Planoceriden mit breitem, ovalem Körper. Mit Tentakeln. Accessorische Samenblasen. Körnerdrüsen-blasen frei. Cirrus mit langen Stacheln. Penis fehlt. Vagina bulbosa nicht bewaffnet. Bursa copulatrix vorhanden. Langsche Drüsenblase vorhanden." Up to the present the following six species have been recorded from several localities in the world.

1. *Paraplanocera langi* Laidlaw

Planocera langi Laidlaw, 1902, p. 286–287; Pl. 14, Fig. 1; Pl. 15, Fig. 13; Text-fig. 62.
Paraplanocera langi Laidlaw, 1903 a, p. 4.
LOCALITY. Minikoi in the Maldive Islands, Indian Ocean.

2. *Paraplanocera rotumanensis* Laidlaw

Paraplanocera rotumanensis Laidlaw, 1903 a, p. 4–7.
LOCALITY. Rotuma in Fiji Islands, Pacific Ocean.

3. *Paraplanocera aurora* Laidlaw

Paraplanocera aurora Laidlaw, 1903 c, p. 102–103; Pl. 9, Fig. 1; Text-fig. 3; Laidlaw, 1904 b, p. 128.
LOCALITIES. Zanzibar, East Africa; Ceylon, Indian Ocean.

4. *Paraplanocera discus* (Willey)

Planocera discus Willey, 1897, p. 155–157; Text-fig. 7 ("egg-disc").
Paraplanocera laidlawi Jacubowa, 1906, p. 3–9; Pl. 1, Figs. 1–9.
Paraplanocera discus Bock, 1913, p. 246.
LOCALITIES. New Britain and New Caledonia, Pacific Ocean.

5. *Paraplanocera misakiensis* Yeri et Kaburaki

Paraplanocera misakiensis Yeri et Kaburaki, 1918, p. 22–25; Pl. 2, Text-figs. 24–26.
LOCALITY. Misaki, Japan.

6. *Paraplanocera marginata* Meyer

Paraplanocera marginata Meyer, 1922, p. 139–145, Pl. 1, Figs. 1–8; Text-figs. 1–2, 3 b.

LOCALITY. Koseir, Red Sea.

In 1932 and '33 numerous specimens which are identical with *P. misakiensis* represented by a single individual were collected in the neighboring coast of the Mitsui Institute of Marine Biology at Susaki near Simoda. In comparison of these with the Misaki form my special attention was paid to many characteristics which have hitherto been overlooked. Here I would not only describe in detail the external and internal characteristics of this species but also revise the genus *Paraplanocera*, so far as examinations are concerned.

Before proceeding further, I wish to tender my hearty thanks to Mr. M. Yeri of the Misaki Marine Biological Station for sending me two Misaki-specimens.

Description of *Paraplanocera misakiensis*

FORM and SIZE. The body is leaf-like, oval in shape, rather firmly textured and strongly frilled at the margin. When at rest it is of an almost circular form. The tentacles are represented by a pair of yellowish conical processes situated at the level of the hind end of the first fourth of the body. The larger specimen measures 30–40 mm long by 20–25 mm across at the middle of the body.

Fig. 1. Dorsal (a) and ventral (b) views of *Paraplanocera misakiensis*. ×1.

COLORATION. The dorsal surface is milky white and shows light yellowish-brown reticulated markings along the intestinal branches. Scattered around the pharyngeal region are found a large number of brownish specks, which are due to the presence of pigments contained on the dorsal side of the intestine. Almost completely around the extreme margin of the body is a dark brownish band which is interrupted here and there by narrow white streaks. In the clarified specimen pigment cells with brownish black granules which lie in the

dorsal parenchyma under the musculature are discernible as minute black spots from the dorsal side, more densely in the mid-dorsal region. Such pigment cells have hitherto been demonstrated in other *Paraplanocera* species, especially in *P. discus* from the dorsal and ventral sides (Jacubowa, 1906). The ventral surface is slightly paler than the dorsal, without any pigment speck. The pharynx, intestinal branches and reproductive organs are discernible to a certain degree from the dorsal and ventral sides.

EYE-SPOTS. The tentacular eye-spots are arranged in a circle at the base of each tentacle and number about 80 in each group. Between the tentacular groups on either side of the brain occur cerebral eye-spots which are less in number than the tentacular ones.

BODY-WALL. The epidermis is as usual higher on the dorsal than on the ventral side and measures along the median line 30 μ and 15 μ respectively. It is made up of slender ciliated cells and contains a large number of spindle-shaped rhabdites of about 5–6 μ long as well as of gland cells filled up with an eosinophilous, fine granular secretion. The basement membrane is rather thick and is found to show a lamellar structure, when fixed with "Susa".

Fig. 2. Eye-spots of *P. misakiensis*. ×30.

Embedded in the parenchyma close to the ventral dermal musculature are a large number of paramarginal glands which secrete a large quantity of eosinophilous granular substances to discharge through the epithelium at the body margin. These glands, though
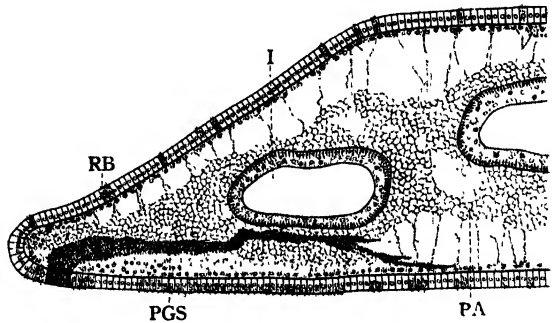
Fig. 3. Transverse section through the lateral part of the body of *P. misakiensis* showing the paramarginal gland. ×100. I intestine, PA parenchyma, PGS paramarginal gland secretion, RB rhabdite.

closely similar to the subcutaneous glands observed in *Cryptocelis ijimai* at the border of the body, in this planarian lie far apart from the body margin. These secretions appear to serve as basis for adhering the body tightly to the substratum on the shore much exposed to the strong surf.

The dermal musculature is better developed on the ventral than on the dorsal side and consists chiefly of the outer circular and the inner diagonal muscle layer. Between these two occur a few longitudinal muscle fibres. Dorso-ventral fibres are sparingly observed. Parenchymatous tissues are densely reticulated and of a highly basophilous nature.

DIGESTIVE-SYSTEM. The mouth is situated at the middle of the body and

leads into the pharyngeal pocket with 4 pairs of lateral-chambers at the hind part. The pharynx is plicated and about one-sixth the body length. The main trunk of the intestine sends out 4–6 pairs of lateral branches, which are repeatedly subdivided before reaching the margin of the body, but cause no anastomosing system. The epithelium of the intestine consists of cylindrical cells nucleated near the base and highly vacuolated so as to make the cell boundaries indistinct. Besides the granular cells of Minot, the epithelium includes here and there a large mass of black pigment granules on the dorsal side, much as in some *Paraplanocera* species other than *langi* and *aurora*.

MALE-GENITAL ORGAN. Embedded in the parenchyma on the ventral side occur numerous small testicular follicles which contain sperm-cells in several stages of development. The seminal canal, filled with a mass of spermatozoa, extends forward as far as the level of the prostate to expand into the accessory seminal vesicle on each side, just before piercing the muscular sheath of the prostate. The seminal canal of the right side pursues a course more outward than that of the left, owing to the occurrence of the bursa copulatrix and receptaculum seminis. The accessory seminal vesicle is lined with a thin epithelium and coated with a thick musculature composed of two sorts of fibres, the inner derived from the local special development of the wall of the seminal canal and the outer from the surrounding musculature of the cirrus cavity. There is no outer nucleated zone which is characteristic to the true seminal vesicle. Consequently this organ appears to be of similar nature and origin to the false seminal vesicle stated by Bock in some Stylochids. The proximal and distal limits of this vesicle can not be observed as in *Leptostylochus elongatus*. Each vesicle gives rise to a narrow efferent duct which proceeds upward for a short distance along the muscular sheath of the prostate and unites with its fellow of the opposite side to form a common median canal, the ejaculatory duct, which stands in communication with the duct of the prostate. The prostate is a large spherical body with a thin muscular sheath, which is continuous with that of the cirrus cavity. Its epithelium is thrown into irregular high folds. Its secretion is generally eosinophilous but slightly basophilous in some parts. The prostate is differentiated at the postero-ventral aspect into a pair of ovoid bodies on either side of the median line, which are clearly limited by a thin muscle layer. Each body passes into a duct running upwards and opens into the duct of the prostate proper at the junction of the latter and the ejaculatory duct. The extracapsular glands of the prostate occur under the dermal musculature on both the dorsal and ventral sides of the central part of the body and make their way into the prostate at its basal part. Posteriorly the prostate passes into the cirrus cavity through the median passage. The cirrus cavity is curved postero-ventrally to open out on the median ventral surface at about one-fourth the body length from the posterior extremity. The inner surface of the cirrus cavity is beset almost uniformly with minute chitinous spines, which are larger in the posterior wide part than in the anterior narrow part. Between these wide and narrow parts a pair of large folds are disposed into the cavity. These folds are covered by a thin

chitinous layer and are entirely devoid of spines. They appear to play a rôle in copulation. With regard to the " penis " of *P. marginata* Meyer states as follows :" Der Penis ist mit chitinigen Stacheln verschiedener Grösse ausgestattet (Taf. 1, Fig. 6 st), ebenso ist der den Penis umgebende Hohlraum mit solchen Stacheln ausgekleidet, die gegen das Antrum masculinum zu kleinen sind und dicht gedrängt stehen. Ungefähr in der Mitte befinden sich zwei ziemlich grosse Stacheln, welche an diejenigen bei *Paraplanocera rotumanensis* Laidlaw erinnern. Bei der eben erwähnten Art, ebenso bei *Paraplanocera laidlawi* Jacubowa und *Paraplanocera misakiensis* Yeri und Kaburaki findet sich wie bei den früher beschriebenen *Planocera graffii* Lang, *Planocera simrothi* Graff usw. stets der mit Stacheln ausgekleidete Cirrus, aber nirgends der in diesen Hohlraum hineinragende Penis, der wahrscheinlich beim Ausstülpen des Cirrus vorgestülpt wird." Judging from this description and figures (Pl. 1, Fig. 4 and 6), she appears to have dealt with a part of the cirrus wall as the penis. The surrounding musculature of the cirrus cavity is well developed and composed of two layers. The outer layer consists of longitudinal muscle fibres. Anteriorly it extends to the wall of the prostate, while posteriorly it runs radially in part on the ventral side and merges in part into the inner musculature of the cirrus cavity. Between the outer and inner musculatures at the anterior half of the cirrus cavity is a wide special cavity, which is usually filled with basophilous filaments. Judging from the structural respect the cirrus cavity seems to be able to protrude while in copulation.
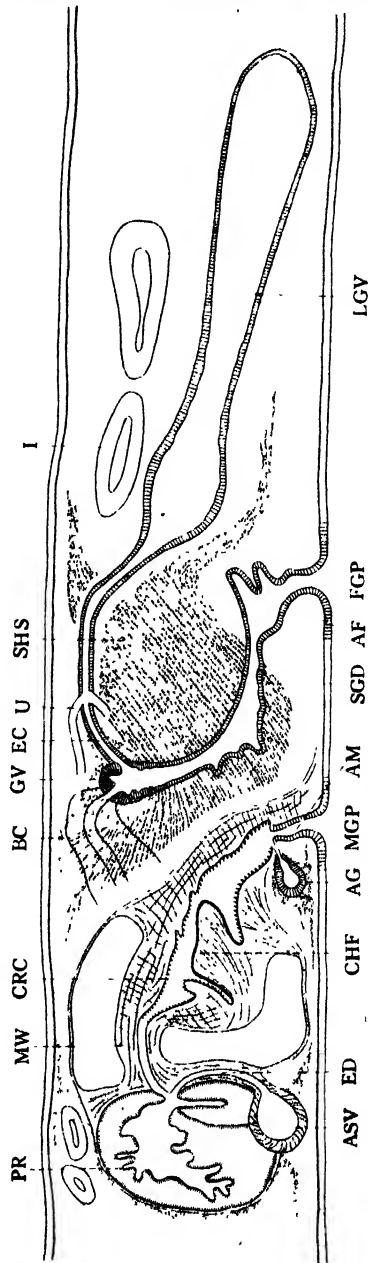
Fig. 4. Genital organs of *P. misakiensis* in longitudinal section, diagrammatic. ×30. AF antrum femininum, AG accessory gland of male genital organs, AM antrum masculinum, ASV accessory seminal vesicle, BC bursa copulatrix, CHF chitinous fold, CRC cirrus cavity, EC egg-canal, ED ejaculatory duct, EGP female genital pore, GV glandular vesicle, I intestine, LGV Lang's glandular vesicle, MGP male genital pore, MW muscle wall, PR prostate gland, SGD shell gland duct, SHS shell secretion, U uterus.

Into the antrum masculinum pass the ducts of the paired "accessorische Drüsen des männlichen Begattungsapparates" demonstrated in *marginata* only. This gland is a simple multicellular body of a spherical or ellipsoidal shape, and is formed by the infolding of the male antrum on each side at the antero-lateral aspect. Jacubowa pointed out some differences in shape and position of this gland according to the specimens from New Caledonia and from New Britain. On examination of numerous specimens of *misakiensis*, however, it has been revealed that this state of things may be due to individual differences. The gland is lined with a layer of cylindrical gland-cells, which have a nucleus at the base. No special muscular coating is observed around this gland, but there exists a large mass of eosinophilous minute granular substances which are limited by the parenchyma with many muscle fibres of the wall of the cirrus cavity. Considering this part as the wall of the gland, Jacubowa says: "Die ziemlich dicke Wandung der Drüse besteht aus zahlreichen Drüsenzellen, welche, im ganzen genommen, das Aussehen einer feinkörnigen, schwach lichtbrechenden und von engen Spalten durchsetzten Masse haben. Wenige Kerne liegen in der Masse zerstreut." So far as observations go, however, no gland cell can be demonstrated among the secretion in *misakiensis*. The secretion observed is that derived from the gland cells scattered in the ventral parenchyma in the central body part and is discharged into the lumen of the gland.

FEMALE GENITAL ORGAN. Ovaries are placed, as usual, on the dorsal part of the body. The uteri, one on each side, are filled with a large mass of ova in the summer and autumn and run backward from the brain finally to open separately into the egg canal from both sides. From this junction point the egg canal is continuous posteriorly with the duct of the Lang's glandular vesicle (accessory vesicle) and anteriorly with the special glandular vesicle of an ovoid shape, which is connected with the 'bursa copulatrix'. At the upper end of the shell gland duct is the ovoid vesicle which has no muscular coating and is lined with a layer of ciliated cylindrical glandular cells. Through the epithelium, a large quantity of granular secretion passes into the lumen from numerous gland cells lying in the parenchyma closely under the mid-dorsal dermal musculature. The secretion, though found in association with that of the shell glands, is easily distinguished from this by having exceedingly small granular shape and more faintly eosinophilous nature. Meyer found out similar vesicle in *marginata*, but appears to have overlooked its glandular nature. She says: "Der Schalendrüsengang mündet dorsal in eine kugelige Erweiterung; diese Erweiterung ist von einem stark gefalteten Epithel ausgekleidet und mit einem dichten Mantel gekreuzter Muskelfasern versehen (Taf. 1, Fig. 7 bc). Von daraus zieht ein Gang (Eiergang, in den die Uterusgänge münden) nach rückwärts und abwärts zu einer langen akzessorischen Blase, der Langschen Drüsenblase. — Die oben erwähnte kugelige Erweiterung des Schalendrüsenganges steht durch einen kurzen weiten Gang mit einer grossen Blase in Verbindung, welche seitlich vom Penis gelegen ist."

The bursa copulatrix runs forward from this vesicle slightly on the left side of the male copulatory organs. It is a highly developed muscular canal

which is folded interiorly and lined with a peculiar chitin-like membrane as described by Jacubowa: "Sie ist von einer stark lichtbrechenden Membran, die sich mit Pikrinsäure intensiv gelb, Säurefuchsin rot färbt, begrenzt." In *misakiensis* the bursa copulatrix is connected at the end with a large blind vesicle occupying a dorso-ventral position as stated by Meyer in *marginata*. This vesicle is coated with an extremely thin musculature, but is lined much as in the bursa copulatrix. It is, as in the bursa copulatrix, filled with a large mass of spermatozoa and eosinophilous coagulated secretion which is probably derived from the prostate gland and is regarded as the 'receptaculum seminis'.

The female genital pore occurs slightly behind the male and leads into the annularly outbulged antrum femininum. This antrum passes forward and upward into the shell gland duct which is enlarged at the upper end to make the ovoid glandular vesicle mentioned above. Around the shell gland duct is observed a large mass of eosinophilous shell secretion, each granule of which is of a peculiar spindle shape much as in the rhabdite but somewhat smaller in size than this. Embedded in the parenchyma in the central part of the body are the shell gland cells which are irregular in shape and contain secretory substances of a spindle shape. Owing to

Fig. 5. Genital organs of *P. misakiensis* in tangential section, diagrammatic. × 30. SC seminal canal, SR seminal receptacle. Other letters as in Fig. 4.

the amount of the secretion the antrum and the shell gland duct differ in space to a considerable extent. Laidlaw at first puts on record the occurrence of

the shell gland cells around the antrum, but in his later paper (1903 d), he states: "In my account of *Paraplanocera langi*, I find I was in error in describing the shell-glands as lying close to the female aperture. A careful reexamination of my sections has shown that there are no shell-glands in that position in any of the three species of the genus at present known, and that the tissue which I supposed to be shell-glands, in the case of *P. langi*, though in a bad state of preservation, is probably muscular."

Notes on six species of *Paraplanocera*

In glancing at six known species of *Paraplanocera* there can be seen two groups, one provided with a pair of glands accessory to the male genital system (*discus, marginata, misakiensis*) and the other without the glands (*langi, aurora, rotumanensis*). With regard to the relationship of the former three species, Meyer states as follows: "Ich erwähne das alles nur in Anbetracht der grossen Ähnlichkeit zwischen *Paraplanocera misakiensis* und *Paraplanocera marginata* n. sp. Ich bedaure, meine Untersuchungen nicht früher publiziert zu haben; es hätte vielleicht die japanischen Forscher veranlasst, noch mehr Material von dieser Art zu untersuchen, und sie wären dann zu ähnlichen Resultaten gekommen wie ich. Eigentümlich ist doch diese auffallende Ähnlichkeit zwischen der Form aus dem Rotes Meer und derjenigen von Japan, obgleich die wenigen bis jetzt bekannten *Paraplanocera*-Arten wie die Planoceriden überhaupt weit verbreitet sind." According to reexamination of numerous specimens, *misakiensis* is marked, as mentioned above, with some characteristics overlooked by previous workers. In fact it is closely similar to *discus* and *marginata* in having the paired accessory gland of the antrum masculinum, the enlarged part at the end of the shell gland duct, the seminal receptacle and some others, though presenting slight differences in coloration as well as in the state of tentacles. To me it seems that the differences are not of sufficient value to separate these forms specifically.

Subsequently in glancing over the descriptions of Laidlaw's three species, I find that *langi* was merely distinguished from *rotumanensis* by the absence of dorsal pigment-containing gut diverticula as well as by the arrangement of eye-spots and from *aurora* by the different coloration of body. On account of the presence of pigment-containing gut diverticula in some specimens of *misakiensis* as well as of the occurrence of a fairly wide variation in coloration and the arrangement of eye-spots even in the same species of some polyclads, however, I think it better to consider that those differences are not of the specific value. Further, I harbour suspicion to overlooking of the paired gland connected with the antrum masculinum.

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4. On Some New Species of Copepoda from Sagami Bay

By Otohiko TANAKA

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(With Plates II-VI)

There has been several reports* on species of the Family *Pontellidae* from the adjacent seas of Japan. The materials here dealt with were collected in Sagami Bay in August, 1933 and 1934, chiefly from the surface by Mr. Y. Matue to whom I am greatly indebted for the valuable materials given to me for examination. One species of *Labidocera* and three of *Pontella*, all new to science, are here described.

(1) *Labidocera bipinnata* n. sp.

Plate II, Figs. 1-10; Plate III, Fig. 1-7.

FEMALE.

Length, 1.16-1.86 mm.

The head has side hooks. The rostrum is short and bifid at the apex. The last thoracic segment is nearly symmetrical. The lateral margins are produced into sharp points.

The abdomen is 3-jointed. The combined length of the abdomen and furca is contained $3\frac{1}{2}$ times in the total length of cephalothorax. The genital segment asymmetrical, with a prominent process on the right side and two setae on the ventral side. The middle segment expands into a wing-shaped projection with a pointed distal end. The anal segment is very short. The furca asymmetical, the left one is about twice as large as the right and bears a protuberance on the inner margin.

The first antennae are 23-jointed and extend about to the end of the genital segment (Pl. II, Fig. 5).

The second antennae, mouth organs and first to fourth swimming feet are nearly similar to the other members of this genus.

The fifth pair of feet are asymmetrical. The outer magin of the exopodite bears two small spines. The left exopodite is furnished with three setae on the inner margin, the apex terminates into three unequal spines. The apex of the right exopodite ends in two spines. The endopodite is differentially denticulated at the apex as in *Labidocera pectinata* Thompson and Scott (Pl. II, Fig. 7).

The female specimen of the fifth copepodid stage has 3-jointed abdomen, nearly symmetrical. The total length 1.35-1.50 mm.

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* *Pontella longipedata* Sato, 1913. *Labidocera rotunda* Mori 1929. *Pontellopsis aequalis* Mori 1932. *Labidocera japonica* Mori, 1935.

MALE.

Length, 1.42–1.62 mm.

The shape of the head resembles that of the female.

The last thoracic segment is asymmetrical, the right side is produced into a bifid process, with several small spines on the posterior margin, while the left side is about same as in the female (Pl. II, Fig. 10).

The 18th joint of the clasping antenna has two rows of fine teeth on the upper margin, the succeeding joint is the longest, with two rows of fine teeth. The 22nd joint is produced on the upper margin distally into a long, slightly denticulated spine about as long as the 23rd joint (Pl. III, Fig. 1).

The thumb-like process on the proximal end of the outer margin of the first joint of the right exopodite of the fifth pair of feet, is stout and curved. The middle of the outer margin is furnished with a small pointed tooth. The claw-like second joint terminates in two spines on the apex (Pl. III, Fig. 2). The left exopodite bears two spines and two setae on the apex, and one stout spine on the inner margin, close to the pad of fine hair. (Pl. III, Fig. 3)

The immature male of this species has the abdomen of four segments. The clasping antenna, the fifth pair of feet and eye-lenses are undeveloped. The total length 1.26–1.38 mm.

The male of this species resembles that of *L. kröyeri* (Brady), but the structure of the clasping antenna and fifth pair of feet separate it from the latter. The female is easily recognised by the large wing-form projection on the genital and middle segment.

Occurrence: 23 females and 68 males in the collection at Misaki in August, 1934.

(2) *Pontella barbata* n. sp.

Plate IV, Figs. 1–11; Plate V, Figs. 1–2.

FEMALE.

Length, 3.35 mm.

The cephalic segment furnished with side hooks and a pair of dorsal eye-lenses. The rostrum are moderately strong, and there is a distinct trace of a lens in the basal part (Pl. IV, Fig. 4). The last thoracic segment is symmetrical. The postero-lateral angles are slightly produced. (Pl. IV, Fig. 3)

The abdomen is composed of two segments. The combined length of the abdomen and furca is contained about 4 times in the total length of the cephalothorax. The genital segment is asymmetrical. The middle portion of the lateral margin of the left side is concave (Pl. IV, Fig. 5). The furcal joints are nearly symmetical.

The antennules are 22-jointed, and reach to the end of second thoracic segment.

The endopodite of the first foot is composed of three joints (Pl. IV, Fig. 7).

The fifth pair of feet is symmetrical and similar to that of *Pontella denticauda* Scott. The apex of the exopodite is spiniform. The distal portion

is furnished with three spines on both the inner and outer margins. The endopodite is spiniform (Pl. IV, Fig. 8).

MALE.

Length, 2.99 mm.

Male resembles female on general appearance. The abdomen is 5-jointed. The combined length of the abdomen and furca is contained nearly 3 times in the total length of the cephalothorax (Pl. IV, Fig. 9).

The proximal hinge joint of the right antennule is furnished with a large saucer-shaped process with a serrate upper edge. The distal hinge joint has two round processes on the upper margin (Pl. IV, Fig. 11).

The fifth pair of feet are well developed. The thumb-like process on the exopodite of the right foot is large and spiniform. It is greatly curved outwards and forms triangle shape. The middle of the joint is furnished with two processes; the one is small and the other is large. The last joint is broad and spoon-shaped (Pl. V, Fig. 1). The last joint of the exopodite of the left foot terminates in two processes. The inner one is spiniform, and furnished with small hairs. The outer one is tongue-shaped. Besides the processes, there are four spines on the joint (Pl. V, Fig. 2).

This species resembles *Pontella denticaudata* Scott, but the female has no projection on the left side of the abdomen as in *P. denticauda*. The structure of the male fifth pair of feet easily separates it from any other members of the genus.

Occurence: One female and one male in the collection off the coast of Misaki in July, 1933.

(3) *Pontella forcipata* n. sp.

Plate V, Figs 3-9; Plate VI, Fig. 1.

MALE.

Length, 2.92–2.95 mm.

The cephalic segment is furnished with side hooks and a pair of dorsal lenses. The rostrum is moderately strong, and there is a trace of lens in the basal part (Pl. V, Fig. 4). The last thoracic segment is symmetrical. The postero-lateral angles are narrowly rounded. The abdomen is composed of five segments (Pl. V, Fig. 6).

The combined length of the abdomen and furca is contained $3^1/_2$ times in the total length of the cephalothorax. The genital segment is symmetrical. The furcal joints are also symmetrical (Pl. V. Fig. 3).

The left antennule is 24-jointed and extends to the end of the third thoracic segment. The middle joints of the right antennule are swollen. The upper margin of the first swollen joint is furnished with a strong spine. The proximal hinge joint has a saucer-shaped process with a serrate upper edge. The upper margin of the distal hinge joint is furnished with two serrate plates and a short stout pointed process (Pl. V, Fig 7).

The fifth pair of feet is well developed. The thumb-like process on the

exopodite of the right foot is spiniform. It is curved inwards and has a lamella at the distal portion. There is a spine at the base of the thumb. The middle of the outer margin is furnished with three teeth. The proximal one has a spine at the upper margin. The last joint is lamelliform and spoon-shaped. The last joint of the expodite of the left foot has three spines and a large pad of fine hairs. The second joint of the exopodite has a spine on distal end of the outer margin (Pl. VI, Fig. 1).

Occurrence: Two males in the collection at Misaki in August, 1934.

(4) *Pontella bifurcata* n. sp.

Plate VI, Figs. 2–12.

FEMALE.

Length, 3.35 mm.

The cephalic segment is furnished with rudimentary cresta, side hooks and a pair of dorsal lenses (Pl. VI, Fig. 3). There is no lens in the rostrum (Pl. VI. Fig, 5). The last thoracic segment is asymmetrical. The postero-lateral angles terminate in two spiniform projections; the outside projection of the left side is curved outwards (Pl. VI, Fig. 4).

The abdomen is 2-jointed. There is a small protuberance on the dorsal side of the genital and anal segment (Pl. VI, Fig. 2). The genital segment is $^1/_2$ time as long as the combined length of the abdomen and furca. The furcal rami are moderately long and asymmetrical (Pl. VI, Fig. 4).

The antennules are 24-jointed and reach to the upper margin of the third thoracic segment.

The endopodite of the first feet is 3-jointed (Pl. VI, Fig. 6).

The fifth pair of feet is symmetrical. The exopodite terminates in a sharp spine. The exopodite bears three spines on both the outer and inner margins. The endopodite ends in a single spine (Pl. VI, Fig. 7).

The immature female of this species has the abdomen of three segments. The furcal rami are symmetrical. Total length 2.39–2.56 mm (Pl. VI, Figs. 8–11).

The female specimen of the fourth copepodid stage measures 1.68–1.74 mm in the total length.

The present species can be distinguished from any of the other members of this genus by the form of the last thoracic segment and the genital segment.

Occurence: One adult and five immature specimens in the collection at Misaki in August, 1934.

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EXPLANATION OF THE PLATES

Plate II

Figs. 1-10, *Labidocera bipinnata* n. sp.

Fig. 1. Female, dorsal view, ×20
Fig. 2. Female, head, lateral view, ×60
Fig. 3. Female, last thoracic segment and abdomen, ventral view, ×38
Fig. 4. Female, last thoracic segment and abdomen, dorso-lateral view, ×60
Fig. 5. Female, first antenna, right side, ×60
Fig. 6. Female, first foot, ×158
Fig. 7. Female, fifth foot, ×158
Fig. 8. Female juv., last thoracic segment and abdomen, dorsal view, ×80
Fig. 9. Female juv., fifth foot, ×158
Fig. 10. Male, dorsal view, ×40

Plate III

Figs. 1-7, *Labidocera bipinnata* n. sp.

Fig. 1. Male, first antenna, right side, ×158
Fig. 2. Male, fifth foot, right side, ×158
Fig. 3. Male, fifth foot, left side, ×158
Fig. 4. Male, abdomen, ventral view, ×80
Fig. 5. Male juv., dorsal view, ×40
Fig 6. Male juv., first antenna, right side, ×80
Fig. 7. Male juv., fifth foot, ×158

Plate IV

Figs. 1-11, *Pontella barbata* n. sp.

Fig. 1. Female, dorsal view, ×20
Fig. 2. Female, head, lateral view, ×38
Fig. 3. Female, last thoracic segment and abdomen, lateral view. ×38
Fig. 4. Female, rostrum, ×108
Fig. 5. Female, abdomen, ventral view, ×60
Fig. 6. Female, first antenna, ×60
Fig. 7. Female, first foot, ×158

Fig. 8. Female, fifth foot, ×158
Fig. 9. Male, dorsal view, ×20
Fig. 10. Male, last thoracic segment and abdomen, lateral view, ×40
Fig. 11. Male, first antenna, ×60

Plate V

Figs. 1–2, *Pontella barbata* n. sp.

Fig. 1. Male, fifth foot, right side, ×160
Fig. 2. Male, fifth foot, left side, ×160

Figs. 3–9, *Pontella forcipata* n. sp.

Fig. 3. Male, dorsal view, ×23
Fig. 4. Male, rostrum, ×80
Fig. 5. Male, head, lateral view, ×40
Fig. 6. Male, last thoracic segment and abdomen, lateral view, ×40
Fig. 7. Male, first antenna, right side, ×80
Fig. 8. Male, first antenna, left side, ×40
Fig. 9. Male, endopodite of first foot, ×160

Plate VI

Fig. 1, *Pontella forcipata* n. sp.

Fig. 1. Male, fifth pair of feet, ×160

Figs. 2–12, *Pontella bifurcata* n. sp.

Fig. 2. Female, lateral view, ×23
Fig. 3. Female, head, dorsal view, ×23
Fig. 4. Female, last thoracic segment and abdomen, dorsal view, ×40
Fig. 5. Female, rostrum, ×80
Fig. 6. Female, endopodite of first foot, ×160
Fig. 7. Female, fifth foot, ×160
Fig. 8. Female juv., copepodid stage V, dorsal view, ×23
Fig. 9. Female juv., copepodid stage V, abdomen, lateral view, ×40
Fig. 10. Female juv., copepodid stage V, fifth foot, ×160
Fig. 11. Female juv., copepodid stage IV, abdomen, lateral view, ×80
Fig. 12. Female juv., copepodid stage IV, fifth foot, ×160

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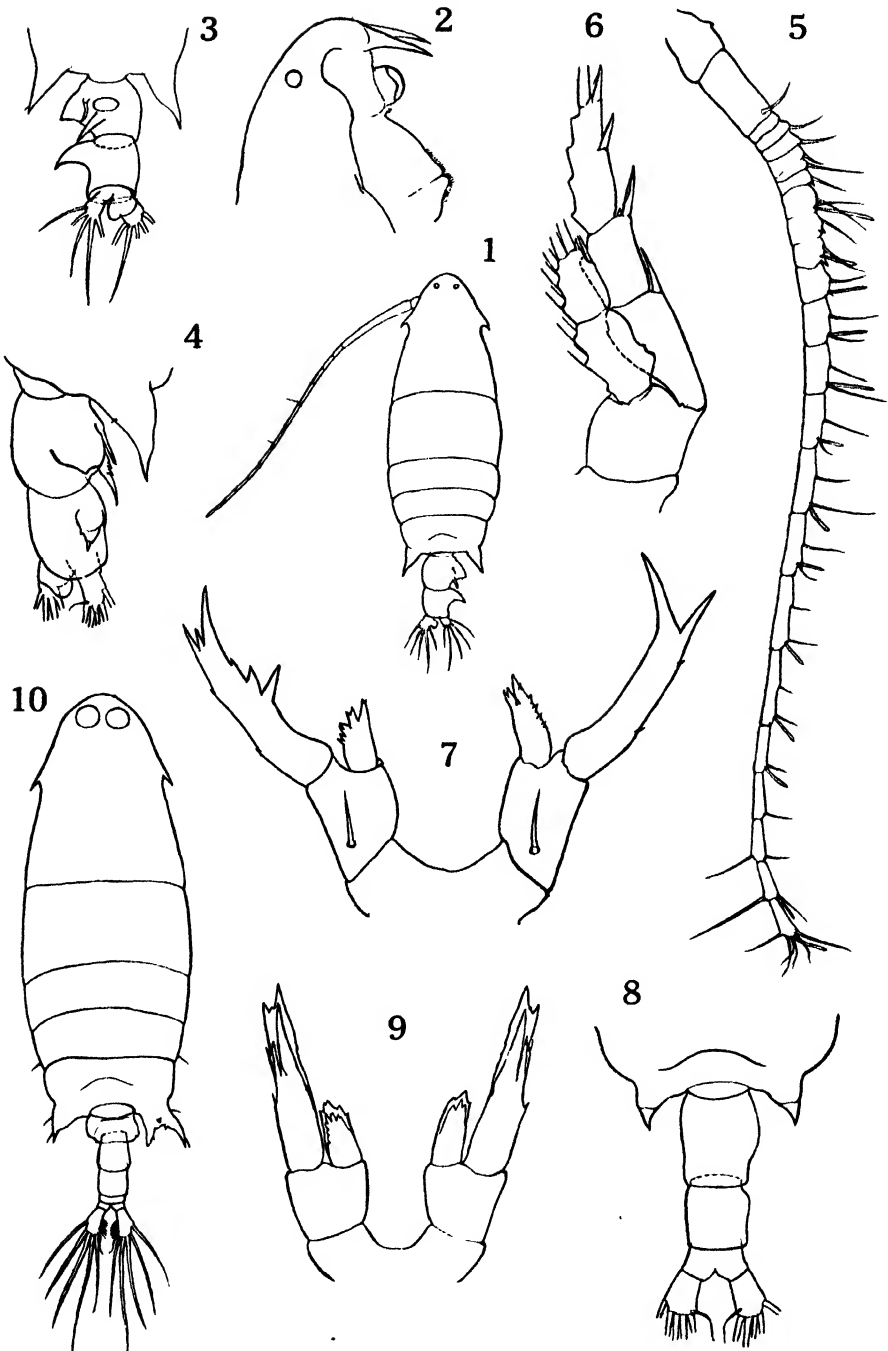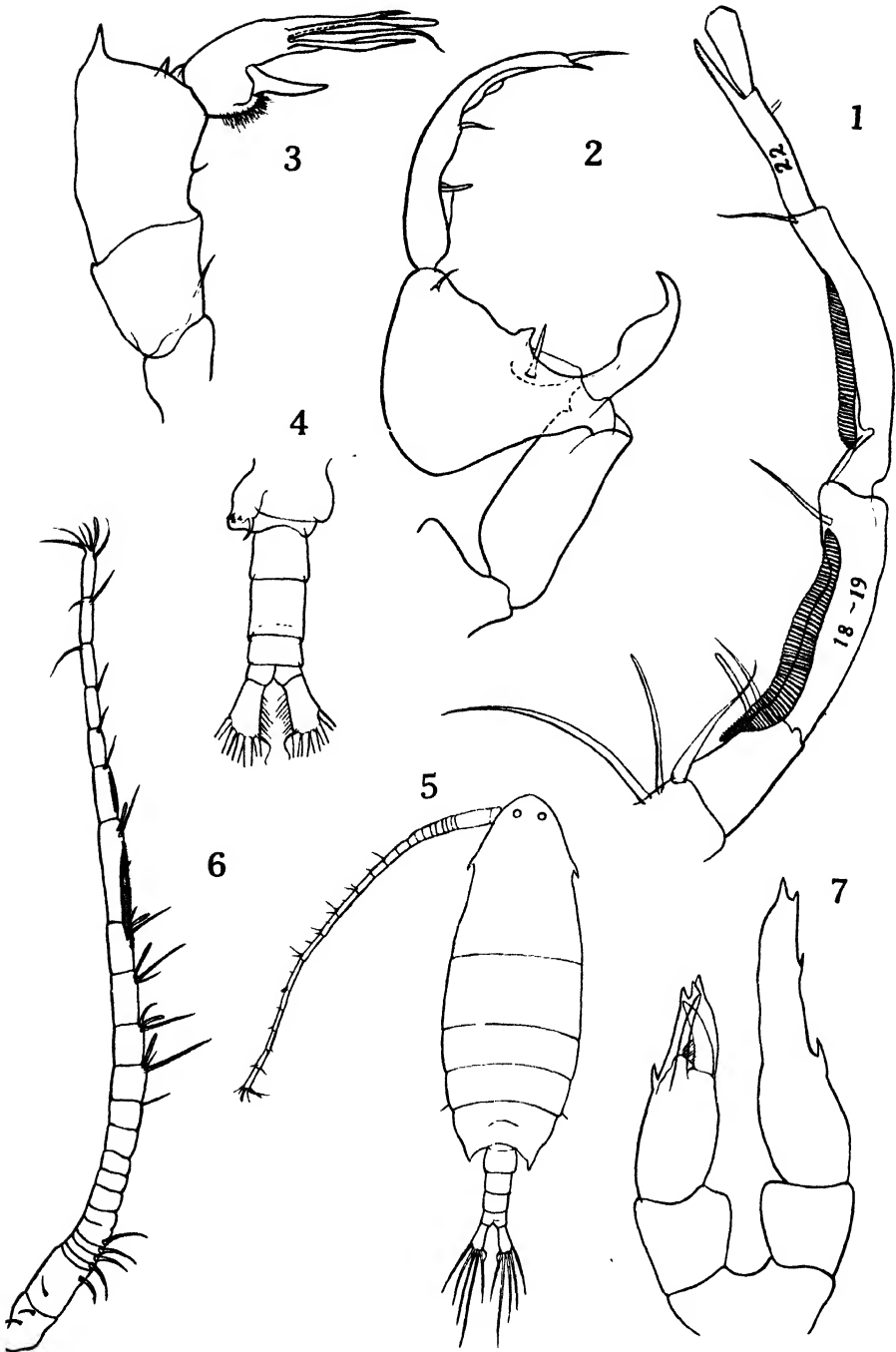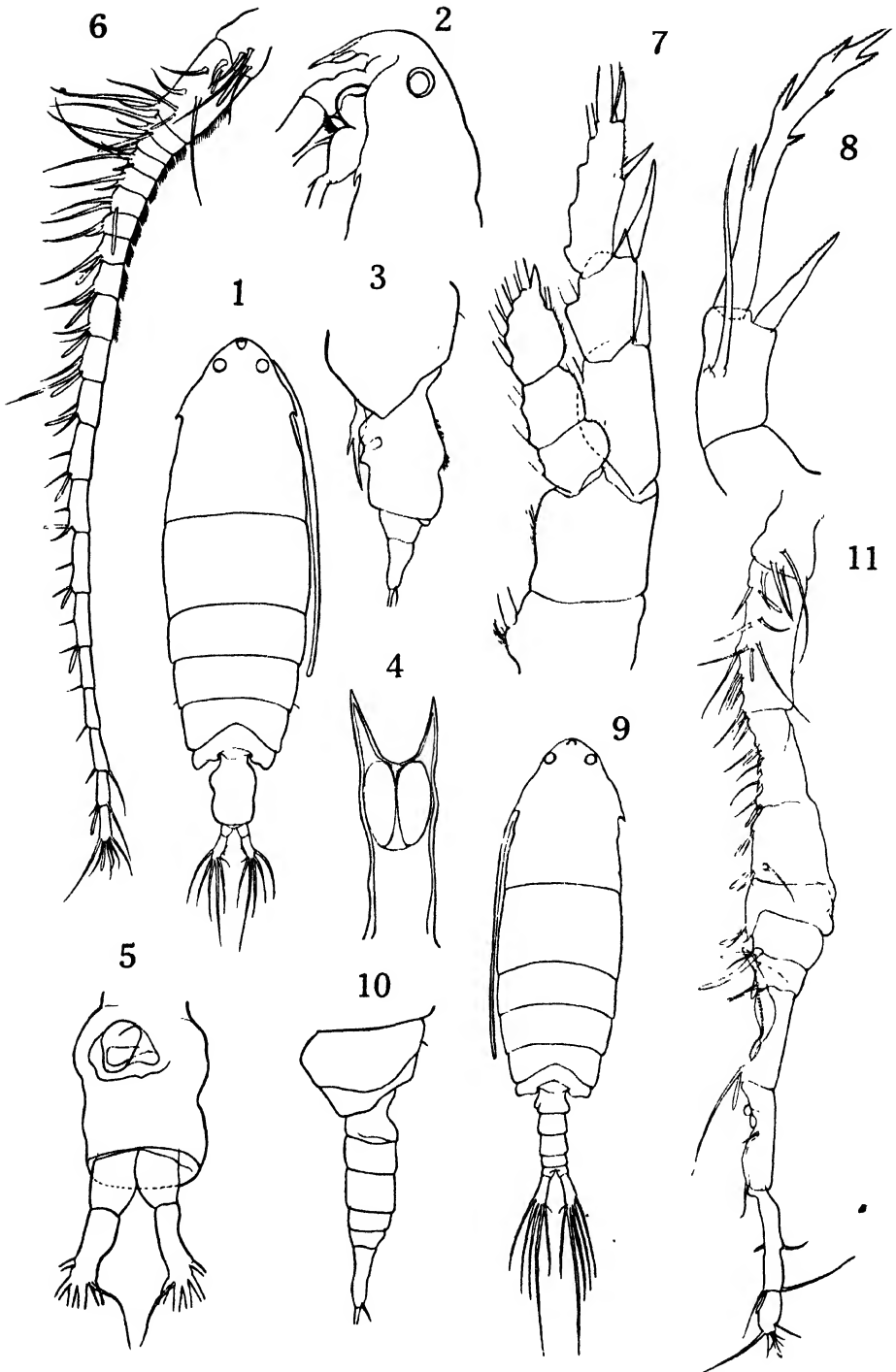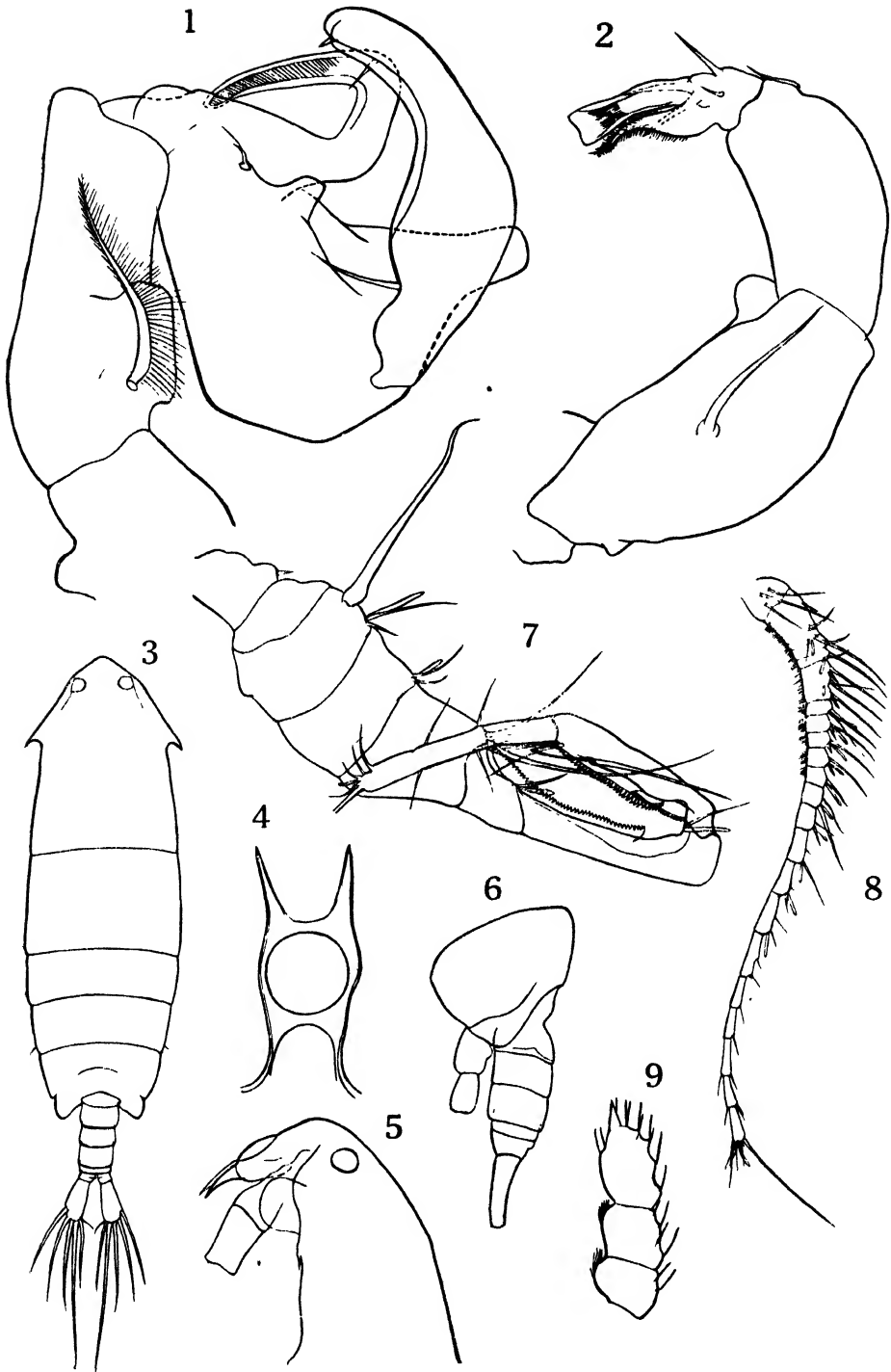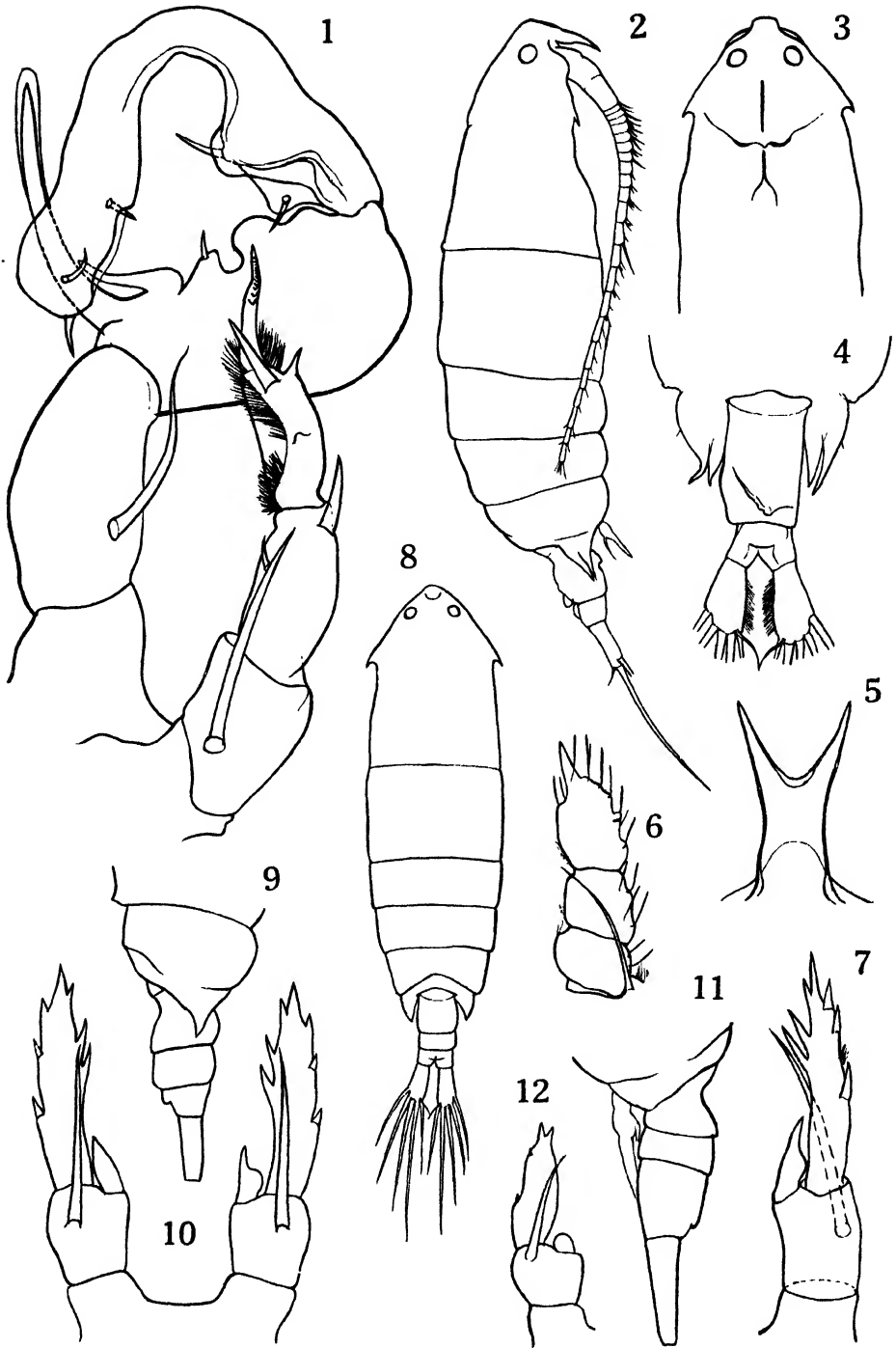
5. Gobiidae of Japan

By Itirô TOMIYAMA

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(With 44 Text-figs.)

Realizing the great importance of variations in taxonomy I have carefully re-examined all the species of the gobies of Japan.

Principally from the differences of the form of vertical and ventral fins the gobies have been grouped into some families or subfamilies by some authorities, but as there are many species with intermediate characters between those of the families or subfamilies, I have united them in a single family Gobiidae.

Some of the species I have divided into two or more *forms*. Most of them have been considered as closely related species or subspecies of a species. The word *form* was suggested by Dr. Shigeho Tanaka in his lecture on the principle of taxonomy given on May 4, 1935, and the trinominal or poly-nominal nomenclature is adopted for *forms*.

Numerous specimens which I have examined are kept in the Science Faculty Museum, a large majority of which have been collected during past thirty years by Dr. Tanaka.

For his continued interests and encouragement I wish to express my sincere thanks to Dr. Shigeho Tanaka under whose guidance the present work has been carried out and who has willingly lent me the pamphlets in his own library invaluable for the preparation of the present paper. And I am greatly indebted to Prof. Naohide Yatsu who has given me many suggestions for this stuty, and to Dr. Hirotaro Hattori, Mr. Toshiji Kamohara, Mr. Saburo Inuo, Mr. Muneaki Abe, Mr. Kiyomatsu Matsubara, Mr. Ken-ichi Ebina, Mr. Syûya Nakamura and Mr. Morizumi Nakamura. All these gentlemen have kindly given or lent me the specimens collected by themselves.
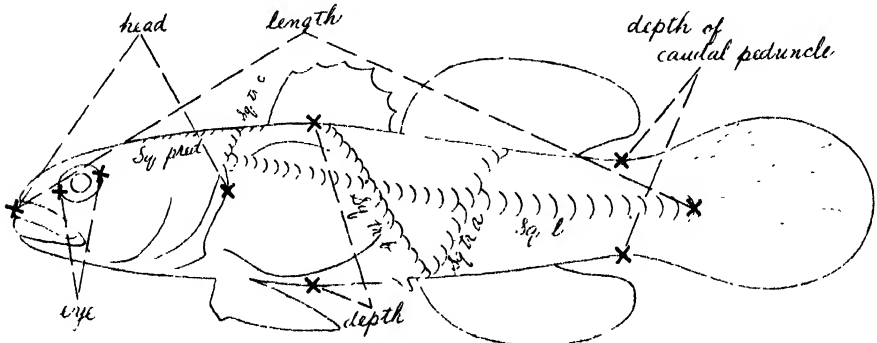
Fig. 1. Sketch showing external characters of a goby.

Key to Japanese genera of Gobiidae

I. **Vertical fins separate; ventral fins separated by a narrow space**
   A. Preopercular margin with 1 or more spines
     B. Head and body much compressed laterally .... *Asterropteryx*, p. 40
    ,BB. Head depressed above; anterior part of body nearly cylindrical or slightly
        compressed; preopercular spine covered by skin................*Eleotris*, p. 41
  AA. Head not armed with spine
    C. Vomer toothed
      D. Scales 30 to 60; lower jaw projecting anteriorly................ *Philypnus*, p. 42
     DD. Scales very small about 150; lower jaw not projecting anteriorly ....
                                    Bostrichthys, p. 43
    CC. Vomer toothless
      E. Head scaly; soft dorsal base shorter than caudal peduncle
        F. Serrated ridge above eye....................................*Butis*, p. 43
       FF. No serrated ridge above eye
         G. Gill-opening extending to below eye.......................*Mogurnda*, p. 44
        GG. Gill-opening not extending to below eye .... *Ophiocara*, p. 45
     EE. Head naked; soft dorsal base as long as or longer than caudal peduncle
       H. Scales 22 to 30...*Eviota*, p. 45
      HH. Scales 70 to 130 .... *Calleleotris*, p. 48

II. **Vertical fins separate; ventral fins close together**
   A. Head naked; body scaly; tip of maxillary ensheathed
     B. Soft dorsal rays less than 15 .... *Xenisthmus*, p. 49
    BB. Soft dorsal rays 25 to 30
      C. No barbels on chin...*Ptereleotris*, p. 49
     CC. Median series of barbels on chin .... *Vireosa*, p. 50
  AA. Head and body naked, with many series of mucous pores; tip of maxillary exposed
                                  Henicichthys, p. 50

III. **Vertical fins separate; ventral fins united at least at base (absent in**
    Luciogobius guttatus parvulus, **an exceptional case)**
   A. Eye not erectile, without eye-lid; pectoral base not arm-like
     B. Ventral sucker without pocket
      C. Spinous dorsal fin absent, or very small and with 3 spines
        D. Head depressed; tip of maxillary embedded below muscles of cheek
         E. Spinous dorsal fin absent .... *Luciogobius*, p. 51
         EE. Spinous dorsal fin present .... *Astrabe*, 53
       DD. Head not depressed; tip of maxillary ensheathed, but not embedded below
          muscles of cheek
        F. Spinous dorsal fin absent; anal fin nearly opposite to dorsal fin ....
                                  Leucopsarion, p. 54
        FF. Spinous dorsal fin present; anal fin much shorter than dorsal fin ......
                                  Eutaeniichthys, p. 54
      CC. Spinous dorsal fin with 5 to 12 spines
        G. Teeth in lower jaw erect
         H. All teeth simple
           I. Head and body naked
            J. Cleft of mouth large, much oblique; lower jaw projecting anteriorly..
                                 Lubricogobius, p. 55
           JJ. Cleft of mouth small, horizontal; jaws subequal .... *Gobiodon*, p. 55
        II. Body scaly; head naked or scaly
          K. One or two pairs of canines behind symphysis of lower jaw, head
            covered with papillary appendages ....*Paragobiodon*, p. 57
         KK. No canines behind symphysis of lower jaw

L. A pair of weak spines directed forward from inner margin of lower
jaw.. *Heteroplopomus*, p. 58
LL. Entire head not armed with spine
  M. No barbels on ventral side of head
    N. Tongue rounded, truncate or weakly emarginate
      O. Spinous dorsal fin with 6 spines
        P. No conspicuous dermal ridges on head
          Q. Postorbital length of head much shorter than 2/3 length
of head
            R. No transverse groove behind interorbital space; no
median dermal ridge on occiput
              S. Tip of maxillary ensheathed
                T. Anterior part of upper lip exposed more or less
                  U. Tongue free from floor of mouth .... *Gobius*, p. 59
                  UU. Tongue adnate below almost to tip
                    V. Lips very thick; snout much longer than twice
diameter of eye .... *Awaous*, p. 75
                  VV. Lips thin; snout shorter than twice diameter
of eye .... *Stenogobius*, p. 75
              TT. Anterior part of upper lip covered by dermal
flap; head and body compressed laterally ....
Amblygobius, p. 76
            SS. Tip of maxillary exposed, extending far behind angle
of mouth .... *Waitea*, p. 77
          RR. Transverse groove just behind interorbital space;
dermal median ridge on occiput....*Oxyurichthys*, p. 78
        QQ. Eye in anterior third of head .... *Cryptocentrus*, p. 80
      PP. Many dermal ridges on top and sides of head and on
lower jaw............................*Callogobius*, p. 83
    OO. Spinous dorsal fin with 8 or more spines
      W. Pectoral fin without free rays; anterior fraenum of ventral
sucker with fringed margin............*Acanthogobius*, p. 84
      WW. Upper pectoral rays free from membrane; margin of
anterior fraenum of ventral sucker smooth ....
Pterogobius, p. 85
  NN. Tongue notched anteriorly
    X. Scales 25 to 40; lower jaw projecting anteriorly ....
Glossogobius, p. 87
    XX. Scales 70 to 100
      Y. Pectoral without free rays; a pair of pores on posterior
part of interorbital space .... *Chaenogobius*, p. 89
      YY. Upper pectoral rays free from membrane; no pores on
posterior part of interorbital space .... *Chasmichthys*, p. 93
MM. Barbels on ventral side of head
  Z. Head depressed
    a. Dorsal rays VI, I-11; head naked ....*Pipidonia*, p. 93
    aa. Dorsal rays VII, I-15 or 16; top and sides of head scaly..
Lophiogobius, p. 94
  ZZ. Head deeper than broad
    b. Pectoral without free rays; scales 28 to 55
      c. About 90 barbels on chin and lower jaw ....
Parachaeturichthys, p. 94
      cc. Lower jaw with 3 pairs of barbels ...... *Chaeturichthys*, p. 94
    bb. Upper pectoral rays free from membrane; scales about 60;
more than 20 barbels on lower jaw...........*Sagamia*, p. 95
HH. Teeth in outer most row in jaws trilobed
  d. No barbels on entire head...............................*Tridentiger*, p. 95

Genus 1. *Asterropteryx* Rüppell

Asterropterix Rüppell, 1828, p. 138 (*A. semipunctatus* Rüppell).
Asterropteryx Günther, 1861, p. 132 (*A. semipunctatus* Rüppell).
Brachyeleotris Bleeker, 1874, Amblyeleotris etc., p. 375; 1877, Eleotriformes, p. 375 (*B. ensifera* Bleeker).

1. *Asterropteryx semipunctatus* Rüppell

Hosi-haze   Fig. 2.

Asterropterix semipunctatus Rüppell, 1828, p. 138, pl. 34, fig. 4; Massaua, Red Sea.
Eleotris cyanostigma Bleeker, 1855, Kokos, p. 452; Cocos Island.
Brachyeleotris ensifera Bleeker, 1874, Amblyeleotris etc., p. 375; Buru. Young with simple elongated preopercular spine.
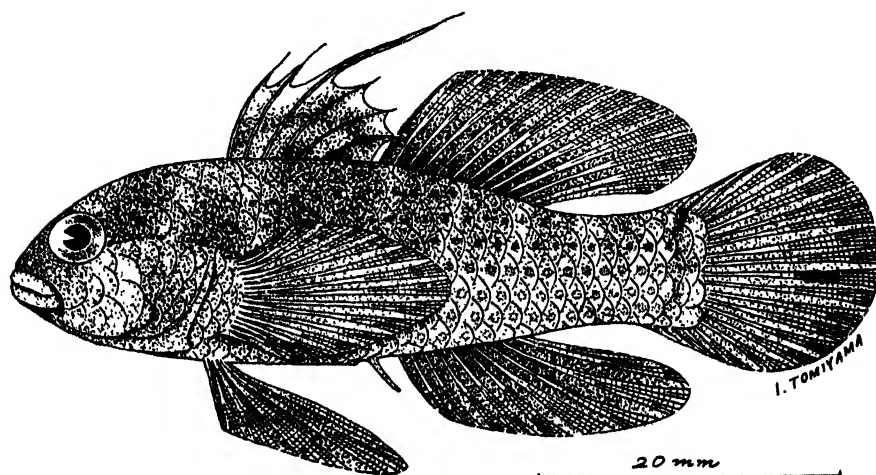
Fig. 2. *Asterropteryx semipunctatus* Rüppell.

Eleotris miniatus Seale, 1901, p. 125; Marianus.
Asterropteryx monacanthus Regan, 1908, p. 240; Seychelles.   D. V, II-9; A. I-8; preoparcle
    with single elongated spine.
Asterropterix semipunctatus quisqualis Whitley, 1932, p. 300; Low Isles. Distinguished
    from typical *semipunctatus* of Red Sea.

Marine goby. Red Sea, East Indies, Queensland, Melanesia, Polynesia
and north to Japan.

Ten specimens 20–60 mm[1]; Saheki, Ôita-ken ; Hatizyô-jima, Idu-siti-tô ;
Onna-mura, Okinawa, Ryûkyû ; Palau.

Genus 2. *Eleotris* Gronow

Eleotris[2] Gronow, 1763, p. 83 (*Gobius pisonis* Gmelin).
Culius Bleeker, 1856, Boero, p. 411; 1877, Eleotriformes, p. 38 (*Cheilodipterus culius*
    Hamilton).

Eleotris pisonis (Gmelin) is a polymorphic and widely distributed species,
and *E. fusca* (Bloch et Schneider) is an oriental form with smaller scales and
hardly distinguished from *pisonis*, and *E. macrolepis* Bleeker is also an oriental
form with larger scales, 40 to 50 in a longitudinal series. Some of American
species belonging to the same genus are hardly distinguished from the oriental
forms.

Key to Japanese forms of *Eleotris pisonis*

a. Scales 45 to 50 in longitudinal series...... . ...*oxycephala*
   b. Scales about 45 in longitudinal series and 15 from end of soft dorsal base
      to base of middle caudal ray . .. .*oxycephala oxycephala*
   bb. Scales about 45 and 15................. . ...*oxycephala tanakae*
   bbb. Scales about 50 and 20......... .. . .*oxycephala melanosoma*
aa. Scales 55 to 65.. *fusca*

2a. *Eleotris pisonis oxycephala* Temminck et Schlegel
Kawa-anagô

Eleotris oxycephala Temminck et Schlegel, 1845, p. 150, pl. 77, figs. 4 and 5; seas of Japan.
Eleotris cantherinus Richardson, 1846, p. 209; Macao. Referred to *oxycephala* by Günther.
Eleotris melosonosoma Bleeker, 1852, Ceram, p. 705; Wahai; West Sumatra.
Eleotris acanthopomus Bleeker, 1853, Sumatra, p. 275; West Sumatra. (*melanosoma* in a
    later paper.)
Culius macrocephalus Bleeker, 1857, Boeroe, p. 70; 1877, Eleotriformes, p. 45; Buru;
    Amboina. Scales 50 to 55; caudal shorter than *melanosoma* Bleeker.
Eleotris balia Jordan et Seale, 1905, p. 526, fig. 6; probably from Hongkong.
Eleotris fortis Tanaka, 1912. Fishes of Japan, vol. 6, p. 106, pl. 27, figs. 108 and 109, pl. 28,
    fig. 113; northern part of Formosa.
?*Eleotris heteruna* Steindachner, 1879, Ichth. Beitr., VIII, p. 36, pl. 2, fig. 1; locality
    unknown. Scales 48 to 50.
?*Eleotris abacurus* Jordan et Gilbert, 1896, p. 228, Charleston, South Carolina. Scales 50.

1) The length of a specimen is measured from the tip of snout to the posterior margin
of caudal fin.
2) Publications with an asterisk are those inaccessible to me.

Fresh and brackish water goby.

1. *Eleotris pisonis oxycephala oxycephala* Temminck et Schlegel. This form agrees well with the figure of *E. oxycephala* given by Tanaka, 1912, Fishes of Japan, vol. 10, p. 174, pl. 47, figs. 184–186 and that of *E. balia* by Jordan and Seale. Japan, Ryûkyû and South China.

2. *E. p. o. tanakae* form. nov. Siduoka-ken to Kagosima-ken, Japan.

3. *E. p. o. melanosoma* Bleeker. This form agrees well with the figure of *E. fortis* given by Tanaka. Kôti-ken, south to Formosa; East Indies; South China.

Numerous specimens 55–230 mm (*E. p. o. oxycephala, tanakae* and *melanosoma*); Watarase River, at Yada, Gunma-ken, south to Ryûkyû and Formosa. One specimen 95 mm (*E. p. o. oxycephala*); Minkiang River, at Fuchau, China. Three specimens 100–160 mm (*E. p. o. melanosoma*); Swatao, China.

2b. *Eleotris pisonis fusca* (Bloch et Schneider)
Tenziku-kawa-anagô

*Poecilia fusca Bloch et Schneider, 1801, p. 453; Oriadae.
Cheilodipterus culius Hamilton, 1822, p. 55, pl. 5, fig. 16; Bengal. Referred to *fusca* by Günther.
Eleotris nigra Quoy et Gaimard, 1824, p. 259, pl. 50, fig. 2. Referred to *fusca* by Günther.
Eleotris brachyurus Bleeker, 1849, Blenn. et Gob., p. 20; Java. (*fusca* in a later paper.)
Eleotris melanurus Bleeker, 1849, Blenn. et Gob., p. 21; Java. (*fusca* in a later paper.)
Eleotris pseudoacanthopomus Bleeker, 1853, Sumatra, p. 276; Sumatra. (*fusca* in a later paper.)
Eleotris inerta Blyth, 1860, p. 146. Referred to *fusca* by Day.
Eleotris soaresi Playfair, 1866, p. 74, pl. 9, fig. 4; Monzambique. Cheeks and lower half of opercle naked.
?*Gobius pisonis* Gmelin, 1789, p. 1206; Rio Almendares, Cuba.
?*Culius perniger* Cope, 1870, p. 474; St. Martius, West Indies.
?*Eleotris carvalhonis* Starks, 1913, p. 65, pl. 9; Lake Parary, Brazil.

Fresh and brackish water goby. East Africa, India, East Indies, Queensland, Polynesia and to Ryûkyû.

Eight specimens 80–110 mm; Amami-Ôsima; Okinawa and other islands of Ryûkyû.

Genus 3. *Philypnus* Cuvier et Valenciennes

Philypnus Cuvier et Valenciennes, 1837, p. 255 (*Philypnus dormitator* Cuv. et val.).
Lembus Günther, 1859, p. 505 (*L. maculatus* Günther).
Perccottus Dybowski, 1877, p. 28 (*Perccottus glehnii* Dybowski).

3. *Philypnus glehni* (Dybowski)
Kôrai-haze

Perccottus glehnii Dybowski, 1877, p. 28.
Eleotris pleskei Herzenstein et Warpachowski, 1887, p. 19, pl. 2, fig. 2; River Lefu, Amur.
Eleotris dybowskii Herzenstein et Warpachowski, 1887, p. 21; between Palus and Chingan, Amur. Fat example.
?*Eleotris glehni* (nec Dybowski) Herzenstein et Warpachowski, 1887, p. 22. Scales smaller, 59 or 60 in a longitudinal series.

Fresh water goby. Northern Korea, Manchuria and northward.

D. VI to VIII, I–10 or 11; A. I–9 or 10; V. I–5. Sq. l. 33 to 37; tr. a. 13 to 15; tr. b. 17 to 19; tr. c. 7 to 9; pred. 21 to 24. Vomer with villiform teeth. Gill-membranes attached to isthmus below midway between eye and preopercular angle.

Sixty-three specimens 40–120 mm; Ranan, Rahoku, Kyôzyô and Syôhei, Kankyôhoku-dô, Korea.

Genus 4. *Bostrichthys* Duméril

Bostrichus Lacépède, 1802, p. 140 (*B. sinensis* Lacépède). Preoccupied by *Bostrichus* Geoffroy, 1762, a genus of insects.
*Bostrichthys Duméril, 1806, p. 332 (*B. sinensis* Lacépède).

4. *Bostrichthys sinensis* (Lacépède)
Zyanome-haze

Bostrychus sinensis Lacépède, 1802, vol. 3, p. 141; vol. 2, pl. 14, fig. 2; China.— Jordan et Tanaka, 1927, p. 272; Miyara River, Okinawa.
Philypnus ocellicauda Richardson, 1845, p. 59; Bocca Tigris. (*sinensis* in a later paper.)
Philypnus ophiocephalus Bleeker, 1849, Blenn. et Gob., p. 20; Surabaya. (*sinensis* in a later paper.)

Fresh and brackish water goby. South China, East Indies and north to Ryûkyû.

Five specimens 140–220 mm; Hainan; Shanghai Market. No Japanese specimens at hand.

Genus 5. *Butis* Bleeker

*Butis Bleeker, 1874, Syst. Nat. Gob., p. 304; 1877, Eleotriformes, p. 59 (*Cheilodipterus butis* Hamilton).

5. *Butis butis* (Hamilton)
Nokogiri-haze Fig. 3.

Cheilodipterus butis Hamilton, 1822, p. 57; Calcutta.
Butis butis Oshima, 1919, p. 272; Taihoku.
Eleotris humeralis Cuvier et Valevcienues, 1837, p. 246; Bengal. Referred to *butis* by Günther.
Eleotris melanopterus Bleeker, 1852, Ceram, p. 113; Bitang; Celebes; Buru; Amboina; Ceram. (*butis* in a later paper.)
*Eleotris longicauda De Vis, 1885, p. 691. Referred to *B. amboinensis* (nec Bleeker) by McCulloch and Ogilby.
Butis leucurus Jordan et Seale, 1905, p. 794, fig. 13; Negros. Referred to *butis* by Jordan and Richardson, 1908.
Butis amboinensis (nec Bleeker) McCulloch et Ogilby, 1919, p. 271, pl. 36, fig. 4; Bisbane River, Queensland; Stickland River, Papua; Ugi, Solomon.

Marine and brackish water goby. East Africa, Andamans, East Indies, Queensland and to Formosa.
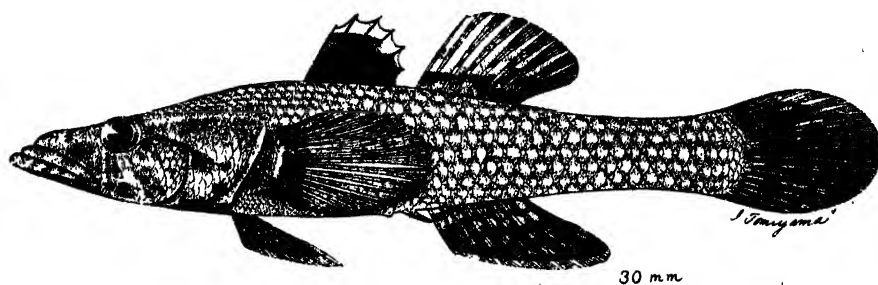
Fig. 3. *Butis butis* (Hamilton).

Three specimens 60–100 mm ; Philippines.   No Japanese specimens at hand.
Butis amboinensis (Bleeker) has no accessory scales.   See the remark given
by McCulloch and Ogilby and by Herre " Gobies of Philippines ", 1927, p. 51.

Genus 6.   *Mogurnda* Gill

Mogurnda Gill, 1863, p. 270 (*Eleotris mogurnda* Richardson).
Odontobutis Bleeker, 1874, Gobioides, p. 305; 1877, Eleotriformes, p. 56 (*Eleotris obscura*
    Temminck et Schlegel).
Krefftius Ogilby, 1897, p. 736 (*Eleotris australis* Krefft).

6.   *Mogurnda obscura* (Temminck et Schlegal)
Donko   Fig. 4.

Eleotris obscura Temminck et Schlegel, 1845, p. 149, pl. 77, figs. 1–3; rivers flowing to
    Nagasaki.
Eleotris potamophila Günther, 1861, p. 557; Yantsekiang. Chinese form.
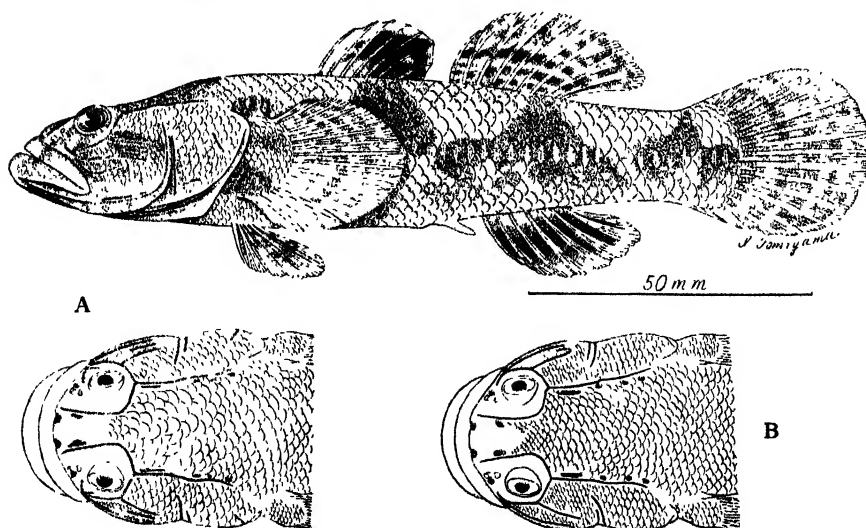
Fig. 4. *Mogurnda obscura* (Temminck et Schlegel).
    A, Japanese form.   B, Chinese form with smaller scales on occiput.

Fresh water goby. Japan, Korea, Manchuria, China and to East Indies.
More than one hundred and fifty specimens 30–195 mm; Kagosima-ken
north to Toyama-ken and Aiti-ken, Japan. One specimen 150 mm; Korea.
Twelve specimens 105–160 mm; Wuchang, Ichang, and Soochow, China.

Genus 7. *Ophiocara* Gill

*Ophiacara Gill, 1863, p. 270 (*Eleotris ophiocephalus* Cuvier et Valenciennes).— Bleeker,
    1877, Eleotriformes, p. 27.

7. *Ophiocara aporos* (Bleeker)

Tametomo-haze

Eleotris aporos Bleeker, 1854, Halmaheira, p. 59; Sidangole; Ternate.
Eleotris hoedtii Bleeker, 1854, Amboina, p. 496: Amboina. Young.
Eleotris tolsoni Bleeker, 1854, On *E. tolsoni*, p. 542; near Djunkulon. (*hoedtii* in a later
    paper.)
Eleotris macrolepidotus (nec Bloch) Günther, 1875, p. 186, pl. 112, figs. B, B′ and B″; East
    Indies; North Australia; Pelew Island, Fiji; New Hebrides.
*Eleotris ophiocephales (nec Cuvier et Valenciennes) Day, 1877, Fishes of India, p. 312, pl.
    67, fig. 2. (*tumifrons* in a later paper.)
Eleotris tumifrons (nec Cuv. et Val.) Day, 1889, p. 292; Andamans; Africa; Malay Archi-
    pelago.
?*Eleotris ophiocephalus* (nec Cuv. et Val.) Barnard, 1927, p. 811, pl. 32, fig. 6; Zululand and
    east coast of Africa. Scales 35–42; maxillary extending to below anterior third of eye.

Marine and fresh water goby. Andamans, Queensland, East Indies and
north to Ryûkyû.

Six specimens 95–195 mm; Okinawa, and Isigaki-zima, Ryûkyû. The
specimens before me agree well with figures of *Eleotris macrolepidotus* given
by Günther.

The specimen of *Sciaena macrolepidota* Bloch was examined by Cuvier
and Valenciennes who named it *Eleotris tumifrons* in which the scales on the
occiput are much smaller than those on the side of body, and *E. tumifrons*
(nec Cuv. et Val.) Day with larger scales on the occiput may be *O. aporos*
(Bleeker), and *E. ophiocephalus* (Kuhl et Hasselt) Cuv. et Val. may be *E.
porocephala* Cuv. et Val. as considered by Günther.

Genus 8. *Eviota* Jenkins

Eviota Jenkins, 1903, p. 501 (*E. epiphanes* Jenkins).
Allogobius Waite, 1904, p. 176 (*A. viridis* Waite).
Asterropteryx (nec Rüppell) Jordan et Snyder, 1901, p. 40 (*A. avax* Jordan et Snyder).

Key to Japanese species and forms of *Eviota*

a. Ventral rays I-4; eye 3 to 4.5 in head; scales about 25 . . . . *abax*
　　b. No dark spots on pectoral base . . . . *abax epiphanes*
　　bb. Two dark spots on pectoral base . . . . *abax abax*

aa.   Ventral rays I–5; eye 2.5 or less in head.
   c.   Scales less than 25; head and body with vermiculation .... *macrophthalmus*
  cc.   Scales 30; longitudinal dark band along upper part of body .... *grammistes*

8a.   *Eviota abax epiphanes* Jenkins

Midori-haze   Fig. 5.

Eviota epiphanes Jenkins, 1903, p. 501; Honolulu.
Allogobius viridis Waite, 1904, p. 177, pl. 23, fig. 3; Lord Howe Island. Male with 2nd
    dorsal spine elongated.
Eviota zonula Jordan et Seale, 1906, p. 386, fig. 75; Apia; Pago Pago. Young of *viridis;*
    cotypes re-examined by McCuclloch and Ogilby, 1919.
Eviota viridis queenslandica Whitley, 1932, p. 301. Darker than *viridis* by Waite.
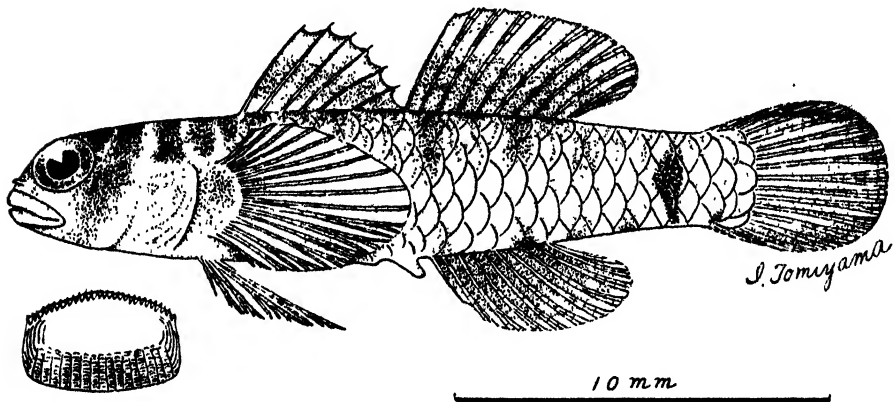
Fig. 5. *Eviota abax epiphanes* Jenkins. A scale below middle of soft dorsal fin.

Marine goby.   Polynesia, Queesland and north to Japan.
Colour in formalin, after long preservation, yellow; 6 transverse dark
shades on body, last one most distinct; 5 dark cross bars in front of spinous
dorsal, anterior 2 ones very dark; vertical fins dark.
Single specimen 25 mm; Okinosima, Kôti-ken.
Fowler has distinguished *E. epiphanes* from *viridis* in " Fishes of Oceania ",
p. 395.

8b.   *Eviota abax abax* (Jordan et Snyder)

Iso-haze

Asterropteryx abax Jordan et Snyder, 1901, p. 40, fig. 2; Misaki, Kanagawa-ken.
Eviota distigma Jordan et Seale, 1906, p. 389, fig. 79; Pago Pago. Young.

Marine goby.   Japan to Polynesia.
In larger male anterior 2 dorsal spines elongated in filaments.
Numerous specimen 13–45 mm; Kominato, Tiba-ken; Misaki, Kanagawa-
ken; Yokkaiti, Mie-ken; Tôsi-tô, an island of Mie-ken; Amami-Ôsima.

9. *Eviota macrophthalmus* sp. nov.

Ôme-haze Fig. 6.

?Trimma caesiura Jordan et Seale, 1906, p. 391, fig. 83; Apia. Occiput scaly to eye.

Marine goby, known from Hatizyô-zima, Idu-sititô.

D. VI. I–9; A. I–9; V. I–5. Sq. l. 23, tr. a. 9, tr. b. 10. Head 3.5 in length, depth 4. Width of body below spinous dorsal 2/3 of depth; head deeper than broad; eye a little shorter than half head length. Teeth in a few rows, these in anterior most row larger and widely spaced; tongue truncated anteriorly; body scaly; head naked. Head and body with vermiculation.
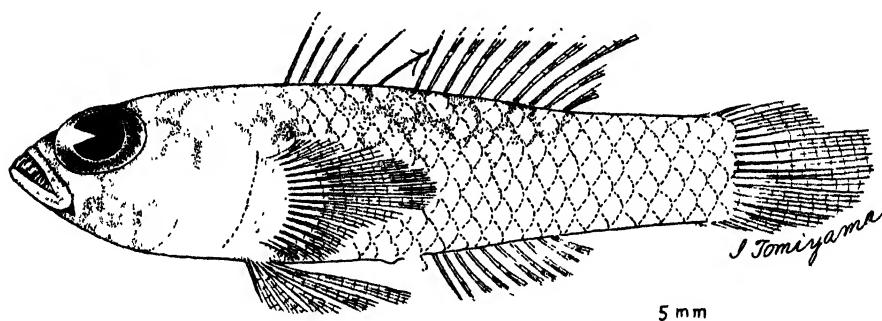
Fig. 6. *Eviota macrophthalmus*. Type.

Type, No. 30331, Science Faculty Museum, 12 mm; Hatizyô-zima, Idu-siti-tô.

This species is distinguished from *T. caesiura* by the absence of scales on the occiput and some other characters.

10. *Eviota grammistes* sp. nov.

Itimonzi-haze Fig. 7.

Marine goby known from Hayama, Japan.

D. VI, I–10; A. I–9; V. I–5. Sq. l. 30; tr. a. 11, tr. b. 12. Head 3.5 in length, depth 4; snout 4 in head, eye 2.5, maxillary 2.5; interorbital 4.5 in eye. Head compressed laterally; width of body below spinous dorsal origin 2/3 of depth; teeth in a few rows, these in outermost row larger; tongue rounded anteriorly; row of conical mitute pores along orbital margin and lower jaw; gill-membranes almost connected each other below middle of eye; scales ctenoid; head and part along spinous dorsal base. naked. Colour in formalin greyish; longitudinal dark band across eye extending along upper part of body; similar narrow one from upper orbital margin to soft dorsal; dorsals dark; other fins pale; caudal with 2 grayish stripes.

Type 30 mm; Hayama. I have had the loan of the type from Dr. Hirotaro Hattori.
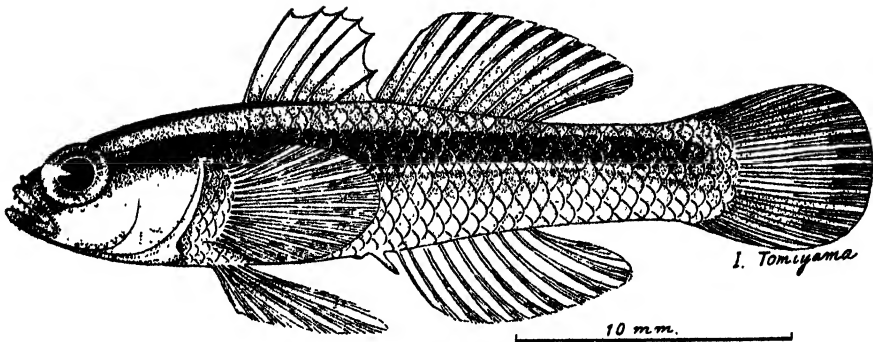
Fig. 7. *Eviota grammistes*. Type.

This species is distinguished from the species belonging to the same genus by the broad gill-openings and the longitudinal dark bands.

Genus 9. *Calleleotris* Gill

Valenciennea Bleeker, 1856, Beoro, p. 412 (*Eleotris strigata* Broussonet). Preoccupied by *Vallenciennia*, a genus of insects.
Calleleotris Gill, 1863, p. 270 (*Eleotris strigata* Cuvier et Valenciennes).
Valenciennesia Bleeker, 1874, Amblyoleotris etc., p. 372; 1877, Eleotriformes, p. 87 (*Eleotris strigata* Cuv. et Val.).
Gobiomorus Gill, 1888, p. 69 (*Gobiomorus taiboa* Lacépède).
Gergobius Whitley, 1930, p. 22 (*Eleotris taeniura* Macleay).

Key to Japanese species of *Calleleotris*

a. Dorsal rays VI, I–11 or 12; anal rays I–11 or 12
     b. Scales 80; 3 broad saddles on back bordered with dark; jet-black spot on end of 5th dorsal spine .... *wardi*
     bb. Scales more than 100
        c. Caudal pointed; 5 ocelli on side of body .... *longipinnis*
        cc. Caudal with 2 filaments; 2 dark bands from snout to end of caudal filaments.. *helsdingeni*

11. *Calleleotris wardi* (Playfair)
Sasa-haze Fig. 8.

Eleotris wardii Playfair, 1866, p. 73, pl. 9, fig. 3; Zanzibar.
Eleotris ellioti Day, 1888, p. 262; Madras.
Valenciennes phaeochalina Tanaka, 1917, p. 223; Tanabe, Wakayama-ken.
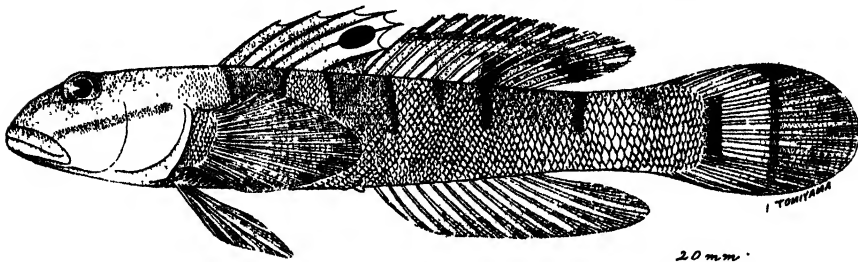
Fig. 8. *Calleleotris wardi* (Playfair).

Marine goby. Zanzibar; Madras; Japan.
Single specimen 85 mm; Okino-sima, Kôti-ken.

12. *Calleleotris longipinnis* (Lay et Bennet)

Sazanami-haze

Eleotris longipinnis Lay et Bennet, 1839, p. 64. pl. 20, fig. 3; Ryûkyû.
*Eleotris taeniura Macleay, 1881, p. 624; Low Island, near Cooktown.
Eleotris muralis (nec Quoy et Gaimard) Ishikawa et Matsuura, 1897, p. 38; Miyako-zima, Ryûkyû.
Eleotris muralis Jordan et Snyder (part.), 1901, p. 42; Ryûkyû.

Marine goby. Ryûkyû south to Queensland.
Five specimens 45–215 mm; Unten, Okinawa and some other islands of Ryûkyû. The smallest one has the rounded caudal margin. I have examined the specimen of *E. muralis* (nec Quoy et Gaimard) Ishikawa et Matsuura and found it identical to the specimens before me with the characteristic ocelli on the side of body.

13. *Calleleotris helsdingeni* (Bleeker)

Kuroito-haze

Eleotriodes helsdingenii Bleeker, 1858, Goram, p. 212; Goram.— Smith et Pope, 1906, p. 489, fig. 9; Urado.

Marine goby, known from Goram and Urado, Kôti-ken, Japan.
No specimens at hand.

Genus 10. *Xenisthmus* Snyder

Xenisthmus Snyder, 1908, p. 105 (*X. proriger* Snyder).
Gignimentum Whitley, 1933, p. 88 (*G. penicillum* Whitley).
?Hetereleotris Bleeker, 1874, Syst. Nat. Gob., p. 306 (*Gobius diadematus* Rüppell).

14. *Xenisthmus proriger* Snyder

Yanagi-haze

Xenisthmus proriger Snyder, 1908, p. 105; 1912, p. 515, pl. 68, fig. 3; Naha, Okinawa.
Gignimentum penicillum Whitley, 1933, p. 89, fig. 4; New Hebrides, perhaps at Vila Harbour.
?!Hetereleotris clara Jordan et Seale, 1906, p. 392, pl. 36, fig. 2; Pago Pago. Palatine toothed.
??Gobius diadematus Rüppell, 1828, p. 137; 1838, p. 137; Suez. Six brown bands on back.

Marine goby known from Naha, Okinawa, Ryûkyû; New Hebrides.
No specimens at hand.

Genus 11. *Ptereleotris* Gill

*Ptereleotris Gill, 1863, p. 271 (*Eleotris microlepis* Bleeker).
Encaeura Jordan et Hubbs, 1925, p. 303 (*Encaeura evides* Jordan et Hubbs).

15. *Ptereleotris microlepis evides* (Jordan et Hubbs)
Kuroyuri-haze

Encaeura evides Jordan et Hubbs, 1925, p. 303, pl, 11, fig. 2; Wakanoura. Young.
Ptereleotris dispersus Herre, 1927, p, 83, pl. 6, fig. 3, Santo Domingo de Basco, Batan Island,
    Batan Prov.; south coast of Cotabato Prov., Mindanao. Adult.
Vireosa sakurai Shmidt, 1931, p. 113, pl. 6, fig. 2; Ituman, Okinawa. Adult.

Marine goby. Japan, Ryûkyû and Philippines.

D. VI, 1–24 or 25; A. I–24. Dark spot on lower part of caudal base
fading away with age.

Six specimens 30–115 mm; Hatizyô-zima, Idu-siti-tô; Yuasa, Wakayama-
ken; Ituman, Okinawa and other locality of the same island.

Ptereleotris microlepis microlepis (Bleeker) has a different markings on
vertical fins and 2 or 3 more rays of both dorsal and anal fins.

Genus 12. *Vireosa* Jordan et Snyder

Vireosa Jordan et Snyder, 1901, p. 38 (*V. hanae* Jordan et Snyder).

16. *Vireosa hanae* Jordan et Snyder
Hana-haze

Vireosa hanae Jordan et Snyder, 1901, p. 38, fig. 1; Misaki, Kanagawa-ken.

Marine goby known from Japan.

Ten specimens 40–130 mm, excluding caudal filaments; Toyama Bay;
Misaki, Kanagawa-ken; Suzaki, Kôti-ken; Kagosima. The youngest specimens
have the caudal filaments not yet produced.

Genus 13. *Henicichthys* Tanaka

Henicichthys Tanaka, 1915, p. 568 (*H. formaminosus* Tanaka).

17. *Henicichthys foraminosus* Tanaka
Akatuki-haze   Fig. 9.

Henicichthys foraminosus Tanaka, 1915, p. 568; Nagasaki.

Marine goby known from Japan.

D. VI, I–10; A. II–9; V. I–5. Head more than 2.5 in length, depth 4
to 5; snout 3.5 to 4 in head, eye 5, interorbital 3.5 to 4.5, maxillary more
than 2. Width of body below spinous dorsal 1/2 to 2/3 of depth; head
compressed; teeth in 1 low in upper jaw, in a few rows in lower jaw; anterior
several ones in upper jaw, 3 or 4 middle ones on each side of lower jaw
and a few ones near anterior tip of lower jaw enlarged; vomer with a few
strong teeth; tongue very narrow; many series of mucous pores on head and
body; gill-opening extending to below eye; gill-membranes free from isthmus.
Colour in formalin yellowish pale.
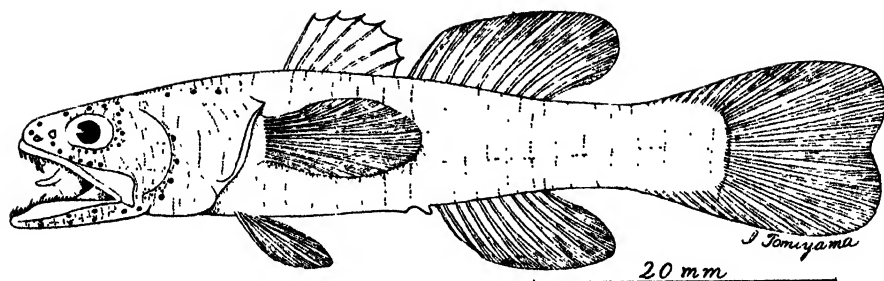
Fig. 9. *Henicichthys forminosus* Tanaka.

Four specimens 35–60 mm ; Nagasaki ; Ôsima, Prov. Suô, Yamaguti-ken; Yokkaiti, Mie-ken ; Kominato, Tiba-ken.

Genus 14.   *Luciogobius* Gill

Luciogobius Gill, 1859, p. 146 (*L. guttatus* Gill).
Inu Snyder, 1909, p. 607 (*I. koma* Snyder).
Expedio Snyder, 1909, p. 617 (*E. parvulus* Snyder).

Key to Japanese forms of *Luciogobius guttatus*

   a. Scales absent
       b.   Ventral sucker absent .... *parvulus*
       bb. Ventral sucker present .... *guttatus*
   aa. Posterior part of body scaly
       c.   Head with conspicuous dermal ridges .... *koma*
       cc. No dermal ridges on head .... *ama*

18a.   *Luciogobius guttatus parvulus* (Snyder)
Nansen-haze

Expedio parvulus Snyder, 1909, p. 607; 1912, p. 445, pl. 61, fig. 1; Misaki, Kanagawa-ken.

Marine goby known from Japan.

This goby is hardly distinguished from an elongate individual of *L. g. guttatus* except the absence of ventral sucker.

Three specimens 35–45 mm ; Konahama, Hukui-ken ; Misaki, Kanagawa-ken.

18b.   *Luciogobius guttatus guttatus* Gill
Mimizu-haze   Fig. 10.

Luciogobius guttatus Gill, 1859, p. 146; Japan.
Luciogobius elongatus Regan, 1905, p. 23; Insland Sea of Japan, Elongate example.

Marine goby, sometimes obtained from a cave or artesian well.   Hokkaidô south to the Island Yaku, Japan ; Korea.

Numerous specimens 14–95 mm ; Takanosima, near Otaru, Hokkaidô to

the Island Yaku, Kagoshima-ken. Two albino specimens 45 mm; Cave of Daikon-zima, Simane-ken. Three specimens 35–65 mm with paler coloration, from artesian well; Gobo, Hidaka-gun, Wakayama-ken; Misaki-mura, Hata-gun, Kôti-ken; Uwazima, Simane-ken.
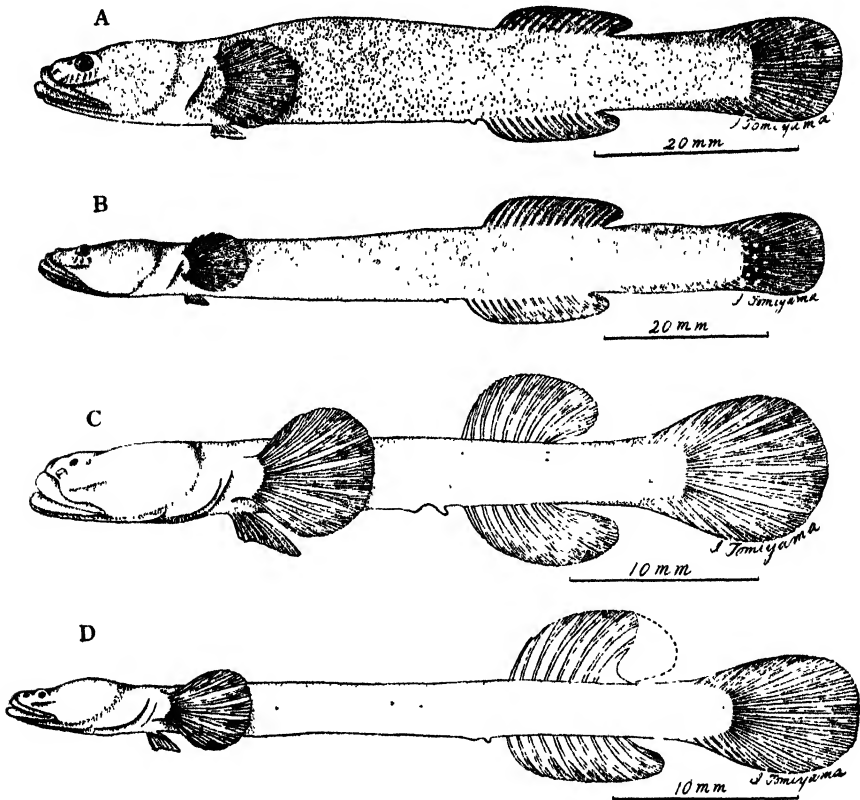
Fig. 10. *Luciogobius guttatus guttatus* Gill.

The specimens collected from the shore exhibit variations in the general form of body, proportion of head and other characters (Fig. 10, A and B). The albinos from the Cave of Daikon-zima have fewer dorsal and anal rays, larger head, the eyes degenerated more or less, and no free pectoral rays (Fig. 10, C). The specimens from the artesian well have the elongate body, fewer dorsal and anal rays, the eyes covered by skin, and no free pectoral rays (Fig. 10, D).

18c.   *Luciogobius guttatus koma* (Snyder)
Koma-haze

Inu koma Snyder, 1909, p. 607; 1912, p. 445, pl. 60, fig. 2; Misaki, Kanagawa-ken.

Marine goby known from Japan.

Sixteen specimens 15–40 mm; Konahama, Hukusima-ken; Misaki, Kana-gawa-ken; Motomura, Ôsima, Idu-siti-tô; Simoda, Siduoka-ken.

18d. *Luciogobius guttatus ama* (Snyder)
Ama-haze

Inu Ama Snyder, 1909, p. 36; 1912, p. 445, pl. 60, fig. 3; Misaki, Kanagawa-ken.

Marine goby, known from Misaki, Kanagawa-ken, Japan.
No specimens at hand.

Genus 15. *Astrabe* Jordan et Snyder

Astrabe Jordan et Snyder, 1901, p. 119 (*A. lacticella* Jordan et Snyder).
Clariger Jordan et Snyder, 1901, p. 119 (*C. cosmurus* Jordan et Snyder).

Key to Japanese forms of *Astrabe lacticella*

a. Body scaly behind pectoral base
   b. Broad white saddle on nape.......................................*lacticella*
   bb. Longitudinal series of lighter spots from upper end of gill-opening to upper
      part of caudal base ....*exilis*
aa. Scales on caudal peduncle extending anteriorly in a single series to below
    spinous dorsal origin at most; distinct longitudinal dark band on side of
    body ....*cosmurus*
aaa. Scales absent
   c. Three pairs of papillae on snout and tip of chin ....*papillosus*
   cc. No papillae on snout; a pair of papillae on tip of chin......*sirahamaensis*

19a. *Astrabe lacticella lacticella* Jordan et Snyder
Sirokura-haze

Astrabe lacticella Jordan et Snyder, 1901, p. 119, fig. 26; Misaki, Kanagawa-ken.

Marine goby known from Japan.

Eight specimens 25–55 mm; Konahama, Hukusima-ken; Kominato, Tiba-ken; Misaki, Kanagawa-ken.

19b. *Astrabe lacticella exilis* (Snyder)
Simohuri-seziro-haze

Clariger exilis Snyder, 1911, p. 544; 1912, p. 444, pl. 60, fig. 1; Tanegasima.

Marine goby known from Japan.

Colour in formalin brownish dark, with a series of lighter spots from upper end of gill-opening to upper part of caudal base and lighter streak along anal base; top of head paler.

Single specimen 30 mm; Misaki, Kanagawa-ken.

19c. *Astrabe lacticella cosmurus* (Jordan et Snyder)
Seziro-hazè

Clariger cosmurus Jordan et Snyder, 1901, p. 121, fig. 27; Misaki, Kanagawa-ken.

Marine goby known from Japan.

More than one hundred specimens 15–40 mm; Misaki, Kanagawa-ken; Motomura, Ôsima, Idu-siti-tô.

19d. *Astrabe lacticella papillosus* (Ebina)
Hige-seziro-haze

Clariger papillosus Ebina, 1934, p. 129, fig. 3; Kominato, Tiba-ken.

Marine goby known from Japan.

Colour in formalin brownish dark, paler below.

Five specimens 20–35 mm; Misaki, Kanagawa-ken; Motomura, Ôsima, Idu-siti-tô. The specimens before me are identical with the type except the absence of the paler band from the tip of snout to the upper part of caudal base.

19e. *Astrabe lacticella sirahamaensis* (Sakamoto)
Seguro-haze

Clariger sirahamaensis Sakamoto, 1932, p. 9, fig. 1; Sirahama, Tiba-ken.

Marine goby known from Sirahama, Tiba-ken.

The type was re-examined.

Genus 16. *Leucopsarion* Hilgendorf

Leucopsarion Hilgendorf, 1880, p. 339 (*L. petersii* Hilgendorf).

20. *Leucopsarion petersi* Hilgendorf
Siro-uwo

Leucopsarion petersii Hilgendorf, 1880, p. 339, fig.; Yedo (Tokyo).

Marine goby entering estuaries to spawn in spring. Japan and Korea.

Numerous specimens 30–55 mm; Aomori-ken to Kagosima-ken.

Genus 17. *Eutaeniichthys* Jordan et Snyder

Eutaeniichthys Jordan et Snyder, 1901, p. 122 (*E. gilli* Jordan et Snyder).

21. *Eutaeniichthys gilli* Jordan et Snyder
Himo-haze

Eutaeniichthys gilli Jordan et Snyder, 1901, p. 122, fig. 28; River Tone.

Brackish water goby. Japan and Korea.

Five specimens 25–50 mm; Haneda, Tokyo; Zyûnityô-gata, Toyama-ken; Kusigahama, Tono-gun, Yamaguti-ken.

Jordan and Snyder have described "body with rudimentary, embedded, rather small cycloid scales", but I have not been able to detect any scales from the specimens before me.

Genus 18. *Lubricogobius* Tanaka

Lubricogobius Tanaka, 1915, p. 568 (*L. exiguus* Tanaka).
Gobiodonella Lindberg, 1934, p. 436 (*G. macrops* Lindberg).

22. *Lubricogobius exiguus* Tanaka
Kigiku-haze Fig. 11.

Lubricogobius exiguus Tanaka, 1915, p. 568; Nagasaki.
Gobiodonella macrops Lindberg, 1934, p. 430, figs. 1 and 2; Misaki, Kanagawa-ken.
Gobiodon gnathus Tomiyama, 1934, p. 330, fig. 3, Misaki, Kanagawa-ken.

Marine goby known from Japan.

Type of *L. exiguus* 25 mm. Type of *G. gnathus* 45 mm. Five specimens 20–35 mm; Nagasaki; Hayama; Misaki, Kanagawa-ken.
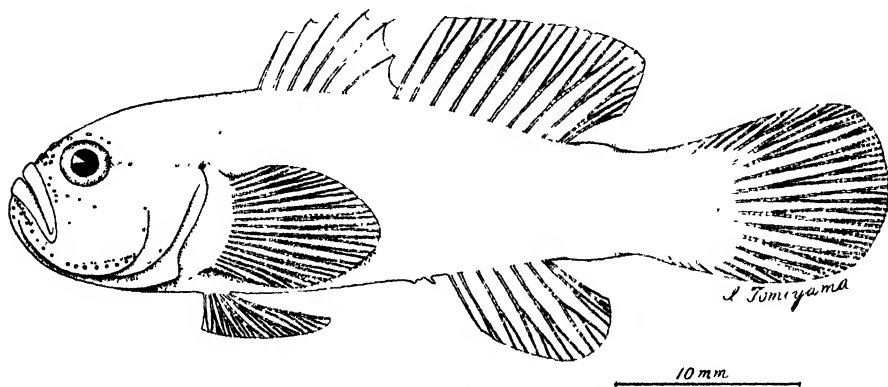
Fig. 11. *Lubricogobius exiguus* Tanaka.

Genus 19. *Gobiodon* Bleeker

Gobiodon Bleeker, 1856, Boero, p. 407 (*Gobius histrio* Cuvier et Valenciennes).
Ellerya Castelnau, 1873, p. 95 (*E. unicolor* Castelnau).
Pseudogobiodon Bleeker, 1874, Syst. Nat. Gob., p. 309 (*P. macrochir* Bleeker).

23. *Gobiodon rivulatus* (Rüppell)
Koban-haze Fig. 12.

Gobius rivulatus Rüppell, 1828, p. 136; Juval. Green, reticulated with red; fins green.

Gobiodon rivulatus Günther, 1861, p. 87; Juval (Rüppell's specimens). Brown in spirits, head lighter with whitish vertical lines.

Gobius coryphaenula Cuvier et Valenciennes, 1837, p. 131; Guam. Uniformly brown.

Gobius histrio Cuv. et Val., 1837, p. 132, fig. 347; Bantan, near Sunda Sound. Rose coloured, with irregular blue spots and streaks, vertical on head, longitudinal on body.

Gobius quinquestrigatus Cuv. et Val., 1837, p. 134; Tongatabu. Reddish brown, with 4 whitish vertical lines on side of head, another one near pectoral base.

Gobius citrinus Rüppell, 1838, p. 139, pl. 32, fig. 4; Massaua. Yellow, with blue streaks along bases of dorsal and anal, 3 similar ones on side of head, another one in front of pectoral base.

Gobius erythrophaios Bleeker, 1848, Sumbawa, p. 637; 1849, Blenn. et Gob., p. 29; Sumbawa. (*quinquestrigatus* Cuv. et Val. in a later paper.)

Gobius ceramensis Bleeker, 1852, Ceram, p. 704; Wahai. (*quinquestrigatus* Cuv. et Val. in a later paper). Entirely black.

*Gobiodon heterospilos Bleeker, 1856, Boero, p. 409; Cajeli. Yellowish rose; head and caudal black dotted; dorsals and anal minutely dotted with brown (Günther).

Gobiodon reticulatus Playfair, 1866, p. 72, pl. 9, fig. 2; Aden. Brownish olive, with network of dark line on body; dorsals and anal black, with white band along base.

Ellerya unicolor Castelnau, 1873, p. 95; half a mile from Eclipse Island, Cape Sidmouth. Light reddish brown after dessication.

*Pseudogobiodon macrochir Bleeker, 1874, Syst. Nat. Gob., p. 309. No canines on symphysis of lower jaw (Koumans, 1931, p. 20).

*Gobiodon hypeleopterus Bleeker, 1875, Gob. spp. nov., p. 120; Moluccas.— Herre, 1927, p. 293, pl. 28, fig. 2; Calapan, Mindro; Canigaram, Palawan. Coloration like that of *citrinus* Rüppell; 4 canines on each side of lower jaw.

*Gobiodon erythrospilus Bleeker, 1875, Gob. spp. nov., p. 122.— Day, 1889, p. 271; Ceylon, Andamans, Nicobars, to Malay Archipelago. Brownish, fins dark, caudal sometimes with a white base or entirely white; 2 small posterior canines above symphysis of lower jaw.

*Gobiodon verticalis Alleyne et Macleay, 1877, p. 333, pl. 12, fig. 4 — McCulloch et Ogilby, 1919, p. 208, pl. 32, fig. 2; Dornley Island (Alleyne and Macleay's cotypes); Murray Island; Cooktown; Green Island; North West Island. A large canine on each side of symphysis of lower jaw; 5 darker cross bands on head and pectoral base; about 5 irregular undurating longitudinal stripes on body in some specimens.

*Gobiodon axillaris De Vis, 1884, p. 448; Bank's Groop. Brown vertical lines on head and blackish red spot above pectoral axil (Fowler, 1928, "Oceania", p. 398).

*Gobiodon lineatus De Vis, 1884, p. 449; Bank's Groop. Smoky brown; bases of pectoral and caudal pale yellow, traversed by slender blue lines (Fowler, 1928, "Oceania", p. 398).

*Gobiodon flavidus De Vis, 1884, p. 449; Bank's Groop; New Hebrides. Pale greenish yellow; orange line from over orbit along opercle edge and on pectoral base, orange band down middle of body and sometimes with 2 short blue lines on cheek (Fowler, 1928, "Oceania", p. 318).

*Gobiodon inornatus De Vis, 1884, p. 449; Bank's Groop; New Hebrides. Flesh-yellow; chin, base of pectoral and caudal yellow; spinous dorsal black edged; obscure purplish streaks beneath dorsal bases (Fowler, 1928, "Oceania", p. 399).

*Gobius douglaci Kent, 1893, p. 310, pl. 16, fig. 12. Referred to *verticalis* by McCulloch and Ogilby.

Gobiodon atrangulatus Garman, 1903, p. 234, pl. 2, fig. 2; off Nairai; Fiji. A small black spot on upper angle of opercle.

Gobiodon fulvus Herre, 1927, p. 292; Calapan, Mindro. Head about 4 in length; a black brown spot at upper posterior angle of opercle; a broad pale yellow band along bases of dorsals and anal.

Marine goby. Red Sea, East Indies, Queensland, Polynesia and north to Japan.

Form of fins, dentition and coloration much variable.

Single specimen 35 mm; Okinosima, an islet of Kôti-ken; reddish pale brown after long preservation with series of white spots along bases of dorsals and anal and a dark spot at upper posterior angle of opercle (Fig. 12, A). Eight specimens 15–40 mm; Koniya, Amami-Ôsima; entirely pale brown becoming brownish dark posteriorly with age; 5 pale vertical streaks on head and
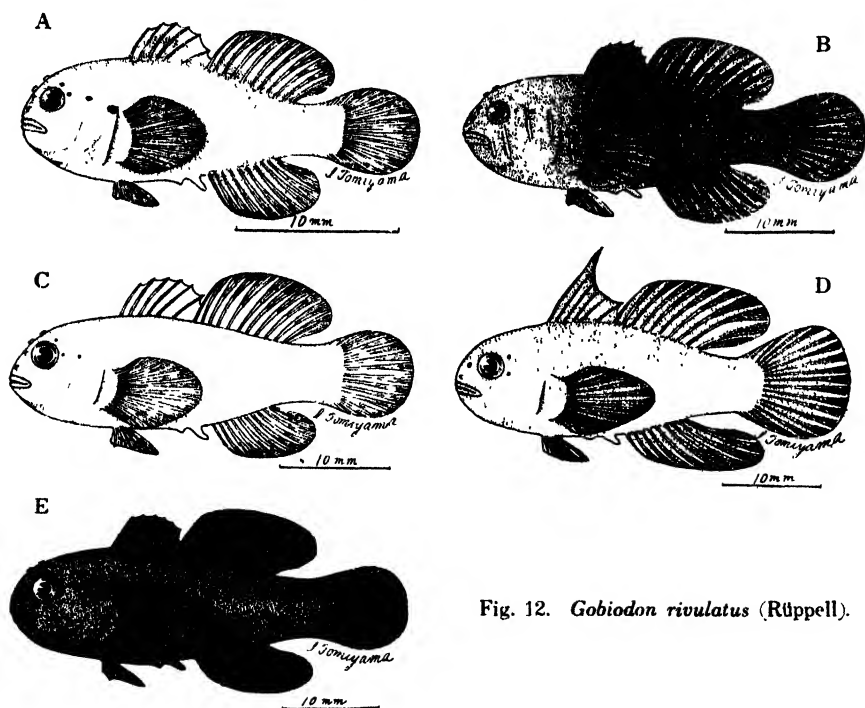
Fig. 12. *Gobiodon rivulatus* (Rüppell).

pectoral base in larger individuals (Fig. 12, B). Four specimens 30–35 mm; Philippines; entirely reddish pale brown after long preservation (Fig. 12, C). Single specimen 40 mm; Palau; no canines behind symphysis of lower jaw; yellow, paler band along bases of dorsals and anal (Fig. 12, D). Five specimens 20–40 mm; Palau; brownish dark, fins black (Fig. 12, E).

Genus 20. *Paragobiodon* Bleeker

Ruppelia and *Ruppellia* Swainson, 1839, p. 184 and 281 (*Gobius echinocephalus* Rüppell). Preoccupied in Diptera.
Paragobiodon Bleeker, 1873, Chine, p. 129 (*Gobius echinocephalus* Rüppell).

24. *Paragobiodon echinocephalus* (Rüppell)
Daruma-haze

Gobius echinocephalus Rüppell, 1928, p. 136, pl. 36, fig. 3; Massaua.

Gobius amiciensis Cuvier et Valevcienves, 1837, p. 135; Tongatabou; Carteret Harbour. Depth lower.

Gobius zanthosoma Bleeker, 1852, Ceram, p. 703; Wahai. Referred to *echinocephalus* by Weber, 1913.

Gobius melanosoma Bleeker, 1852, Ceram, p. 703; Wahai. Referred to *echinocephalus* by Weber, 1913.

Gobius gobiodon Day, 1869, p. 516; Andamans or adjacent islands. (*melanosoma* in a later paper.)

*Gobius gibbosus Macleay, 1881, p. 601; Endeavour R., Queensland. Referred to *echinocephalus* by McCulloch and Ogilby, 1919.

*Gobius scabriceps Macleay, 1881, p. 603; Endeavour R., Queensland. Referred to *echinocephalus* by McCulloch and Ogilby, 1919.

Gobius waitii Garman, 1903, p. 234, pl. 3, fig. 3; Cairus, Great Barrier Reef, Australia. Scales on head hidden; head with short sharp points or flaps of skin.

Gobiopterus modestus Regan, 1908, p. 242, pl. 29, fig. 1; Chagos Archipelago, Egmont and Salomon. Figure very characteristic.

Ruppellia lacunicola Kendall et Goldsborouch, 1911, p. 318, pl. 6, fig. 1; Fakarava, Paumotus. No papillae on head; type was re-examined by Fowler, 1928, "Oceania", p. 399.

Paragobiodon kerri Smith, 1931, p. 42, fig. 20; Koh Tao, Gulf of Siam. A row of short wide-spaced spines or papillae on opercle.

Marine and brackish water goby. Red Sea, India, East Indies, Queensland, Polynesia and north to Ryûkyû.

Four specimens 25–30 mm; Amami-Ôsima; Philippines; Palau.

Paragobioides grandoculis Kendall et Goldsborough, 1911, was referred to *Paragobiodon echinocephalus* (Rüppell) by Fowler, 1928, but these two are not identical.

Genus 21.　*Heteroplopomus* gen. nov.

This genus is distinguished from other genera of Gobiidae by the presence of a pair of weak spines directed forward from the inner margin of lower jaw.

Type of genus.　*Rhinogobius barbatus* Tomiyama.

25.　*Heteroplopomus barbatus* (Tomiyama)
Nirami-haze　Fig. 13.
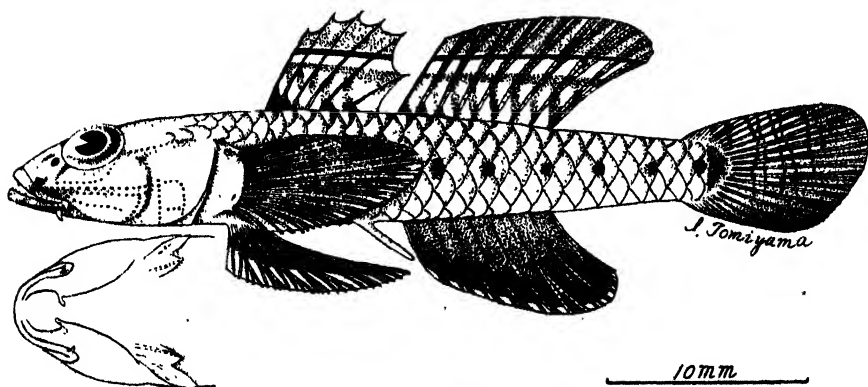
Fig 13.　*Heteroplopomus barbatus* (Tomiyama).

Rhinogobius barbatus Tomiyama, 1934, p. 325, fig. 1; Ariake Sound.
?? *Gobius baliuloides* Bleeker, 1849, Blenn. en Gob., p. 26; Sumanap, Madura.

Brackish water goby, known from Japan.

Type 45 mm. Six specimens 40–45 mm; Ariake Sound; Hirosima.

Whether or no *G. baliuloides* Bleeker has the weak spines on lower jaw and the papillae on lip is not certain.

Genus 22. *Gobius* Linnaeus

Gobius Linnaeus, 1758, p. 262 (*Gobius niger* Linnaeus).
*Ctenogobius Gill, 1858, p. 374 (*C. fasciatus* Gill).
Rhinogobius Gill, 1859, p. 145 (*R. similis* Gill).
*Coryphopterus Gill, 1863, p. 263 (*C. glaucofraenum* Gill).
*Gnatholepis Bleeker, 1874, Syst. Nat. Gob.. p. 318 (*Gobius anjerensis* Bleeker).
*Acentrogobius Bleeker, 1874, Syst. Not. Gob., p. 321 (*Gobius chlorostigma* Bleeker).
*Porogobius Bleeker, 1874, Syst. Not. Gob., p. 321 (*Gobius schlegelii* Günther).
*Zonogobius Bleeker, 1874, Syst. Nat. Gob., p. 323 (*Gobius semifasciatus* Kner).
*Bathygobius Bleeker, 1878, New Guinea, p. 54 (*Gobius nebulopunctatus* Cuvier et Valenciennes).
*Mapo Smitt; 1899, p. 551 (*Gobius soporator* Cuv. et Val.).
*Mugilogobius Smitt, 1899, p. 552.— Jordan, 1920, Genera, p. 487 (*Ctenogobius abei* Jordan et Snyder).
Hazeus Jordan et Snyder, 1901, p. 51 (*H. otakii* Jordan et Snyder).
Quisquilius Jordan et Evermann, 1903, p. 203 (*Q. eugenius* Jordan et Evermann).
Chlamydes Jenkins, 1903, p. 503 (*C. laticeps* Jenkins).
Vaimosa Jordan et Seale, 1906, p. 395 (*V. fontinalis* Jordan et Seale).
Drombus Jordan et Seale, 1906, p. 399 (*D. tutuilae* Jordan et Seale).
Exyrias Jordan et Seale, 1906, p. 405 (*Gobius puntangoides* Bleeker).
Pleurogobius Seale, 1909, p. 536 (*P. boulengeri* Seale).
Opua E. K. Jordan, 1925, p. 36 (*O. nephodes* E. K. Jordan).
Tukugogius Herre, 1927, p. 119 (*T. bucculentus* Herre).
Pandaka Herre, 1927, p. 196 (*P. pusilla* Herre).
Cingulogobius Herre, 1927, p. 201 (*Pleurogobius boulengeri* Seale).
Tamanka Herre, 1927, p. 220 (*T. siitensis* Herre).
Amoya Herre, 1927, p. 225 (*Gobius brevirostris* Günther).
Berowra Whitley, 1928, p. 224 (*Gobius lidwilli* McCulloch).
*Fusigobius Whitley, 1930, p. 122 (*Gobius neophytus* Günther).
Istigobius Whitley, 1932, p. 301 (*Gobius maculatus* Castelnau).

See the synonyms of *Gobius* and its subgenera given by Koumans, 1931, p. 43.

Key to Japanese species and forms of *Gobius*

a. Anterior nostril apart from upper lip more or less
  b. Ventral sucker without anterior fraenum
    c. Head, breast and belly naked
      d. Scales 22 to 25; head and anterior part of body crossed by bands ....
                                 semidoliatus
      dd. Scales 30 or more; head crossed by bands; body without markings ......
                                 farcimen
    cc. Occiput and upper part of opercle scaly............................. *eugenius*
  bb. Ventral sucker with anterior fraenum
    e. Upper lip making anterior margin of snout

f. Upper pectoral rays free from membrane
  g. Sides of head scaly more or less; scales 36 to 39 ....*cotticeps*
  gg. Sides of head naked
    h. Interorbital width equal to diameter of eye; scales 33 to 36; head and body dark; fins blackish, with pale margin ....*villosus*
    hh. Interorbital width about half diameter of eye; scales 36 to 39; markings variable (see Fig. 17).....................................*fuscus*
ff. Pectoral without free rays
  i. Sides of head naked
    j. Width of body below spinous dorsal about half of depth; head compressed; scales 27 or 28; dark spots on sides of head ....*viganensis*
    jj. Head and body compressed dorsally, triangular in cross section; scales 26; body with 7 longitudinal series of dark dots..........*neophytus*
    jjj. Anterior part of body nearly cylindrical or moderately compressed, with width 2/3 or more of depth
      k. Snout short, more or less than diameter of eye
        l. Gill-membranes almost connected each other on ventral side of head; scales about 30; a pale longitudinal band on cheek ......
                      macropteryx
        ll. Gill-membranes attached to isthmus
          m. Scales 22; anterior half of spinous dorsal black ....*lidwilli*
          mm. Scales 27 to 30
            n. Interorbital space very narrow
              o. Nuchal region scaly; longitudinal dark streak below eye ....
                      pflaumi
              oo. Nuchal region naked; irregular 5 dark spots along side of body.....................................*gymnauchen*
            nn. Interorbital width about half diameter of eye; 5 dark blotches along side of body; 4 dark saddles on back ......*nebulosus*
      kk. Snout long, about twice or more diameter of eye
        p. Scales about 30; scales on occiput extending almost to eye; snout and sides of head with dark vermiculation in larger individuals
                      giurinus
        pp. Scales 35 or more; scales on nape extending to above upper posterior angle of preopercle at most; no vermiculation on head in larger individuals ....*similis*
ii. Upper part of opercle scaly more or less
  q. Snout not so longer than diameter of eye; no series of conspicuous mucous pores on cheek
    r. Maxillary extending to below anterior margin of eye; scales about 30; a jet-black spot above pectoral base ....*caninus*
    rr. Maxillary extending to below middle of eye; scales about 35; an indistinct blotch above upper end of gill-opening....*viridipunctatus*
  qq. Eye small, 2 in snout; 5 series of mucous pores on cheek; scales about 30 ....*masoni*
iii. Opercles covered with several large scales; scales about 25; spinous dorsal with several jet-black spots.........................*tessellata*
iiii. Upper halves of opercle and preopercle covered with scales; scales about 30...*validus*
iiiii. Sides of head scaly
  s. Scales on cheek divided into 3 groups by 2 longitudinal grooves; scales about 30 ....*puntang*
  ss. Scales on cheek not divided into groups by grooves
    t. Scales about 25; 5 dark spots along side of body ....*otakii*
    tt. Scales about 30; dark vertical band below eye; 6 large dark blotches on lower part of body ....*knighti*

  ee. Snout projecting anteriorly above upper lip .... *ornatus*
   u. Upper pectoral rays free from membrane, scales 26 to 28; body with longi-
    tudinal dark streaks and series of dots .... *ornatus ornatus*
   uu. Pectoral without free rays
    v. Head 3.5 in length; dorsal rays VI, I-10 or 11; anal rays I-9 or 10;
     occiput scaly to eye
     w. About 10 scales in front of spinous dorsal; body with longitudinal dark
      or obscure streaks and series of dots .... *ornatus campbelli*
     ww. About 20 scales in front of spinous dorsal; body with 4 indistinct
      blotches on side .... *ornatus hoshinonis*
    vv. Head 4 in length; dorsal rays VI. I-7; anal rays I-7; scales on occiput
     not extending to eye .... *ornatus masago*
 aa. Anterior nostril close to upper lip, with conical tube directed downward on upper
  lip; occiput and opercle scaly
  x. Scales about 40; 2 longitudinal dark bands on posterior half of body extending
   on caudal... *abei*
  xx. Scales more than 50; body and caudal crossed by dark irregular bands.. *tagala*

26. *Gobius semidoliatus* Cuvier et Valenciennes
Irezumi-haze

Gobius semidoliatus Cuvier et Valenciennes, 1837, p. 67; Vanicolo, Red Sea.
Zonogobius semidoliatus Snyder, 1912, p. 442; Tanegasima, Kagosima-ken.
*Gobius semifasciatus Kner, 1868, p. 326, fig. 15. Referred to *semidoliatus* by Günther.

Marine goby. Red Sea, Andamans, East Indies, and to Polynesia and
Japan.
No specimens at hand.

27. *Gobius farcimen* (Jordan et Evermann)
Misaki-irezumi-haze

Gobiopterus farcimen Jordan et Evermann, 1903, p. 205; 1905, p. 482, pl. 59; Hilo, Hawaii.
 Hawaiian form with 3 vertical pairs of pale brown cross-lines over side of head.
Zonogobius boreus Snyder, 1909, p. 605; 1912, p. 442, pl. 59, fig. 3; Misaki, Kanagawa-ken.

Marine goby known from Hawaii and Japan.
Four specimens 30–35 mm; Kominato, Tiba-ken; Misaki, Kanagawa-ken;
all these agree with *Z. boreus* Snyder with five light cross bands on the head
and neck. In typical *farcimen* of Hawaii the cross bands on head are narrower
and fewer in number.

28. *Gobius eugenius* (Jordan et Evermann)
Benkei-haze Fig. 14.

Quisquilius eugenius Jordan et Evermann, 1903, p. 203; Waikiki, Hawaii.
Amblygobius naraharae Snyder, 1908, p. 101; 1912, p. 515, pl. 68, fig. 2; Tanegasima; Naha,
 Okinawa.
*Quisquilius profundus Weber, 1909, p. 155; 1913, p. 483, fig. 100; Sapeh Strait; Dongala,
 Palos Bay. Head broader than wide.
Pleurogobius boulengeri Seale, 1909, p. 536; Puerto.
Cingulogobius boulengeri Herre, 1927, p. 201, pl. 16, fig. 1. Based on Seale's type; 9 scales
 before spinous dorsal.

Marine goby. Hawaiian Islands; Japan south to East Indies.

D. VI, I–11; A. I–9; V. I–5. Sq. l. 30 to 33; tr. a. 12 or 13; tr. b. 19 to 21; tr. c. 10; pred. about 20. Head scarcely deeper than wide. Ventral sucker, bilobed posteriorly, without anterior fraenum.

Two specimens 25 and 35 mm; Hatizyô-zima, Idu-siti-tô.
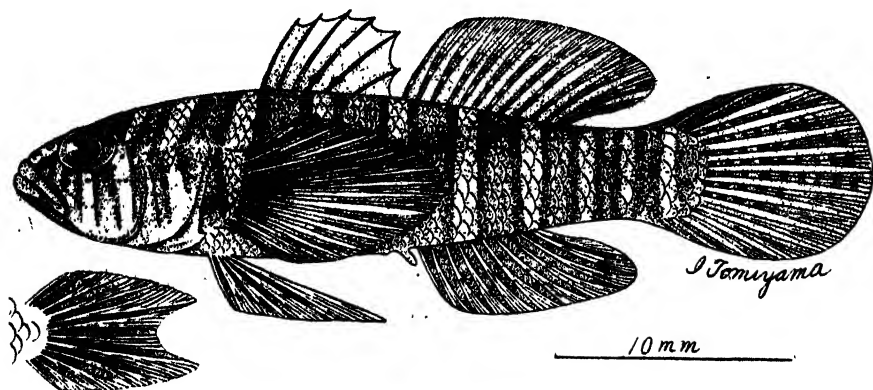
Fig. 14. *Gobius eugenius* (Jordan et Evermann).

29. *Gobius cotticeps* Steindachner

Kusabi-haze Fig. 15.

Gobius cotticeps Steindachner, 1879, Ichth. Beitr., VIII, p. 19, pl. 1, fig. 2; Society Islands.
Chlamydes laticeps Jenkins, 1904, p. 503, fig. 43; Honolulu. Chestnut brown in spirits, with a few darker mottlings on side of body.
Chlamydes leytensis Herre, 1927, p. 118, pl 8, fig. 3; Cabalian, Leyte.

Marine goby. Society Islands; Hawaiian Islands; Philippines north to Japan.

Sixteen specimens 20–60 mm; Ôsima, Idu-siti-tô; Okino-sima, Kôti-ken; Yaku-sima, Kagosima-ken. The general coloration of larger individuals is very pale. The specimens from Ôsima, Idu-siti-tô, have no scales on the side of head.
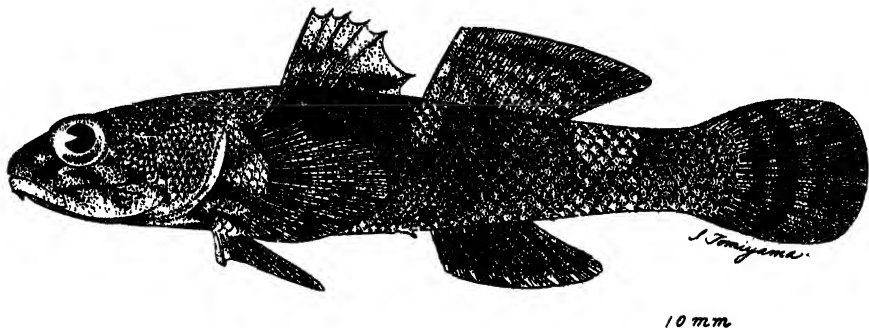
Fig. 15. *Gobius cotticeps* Steindachner.

30. *Gobius villosus* Weber

Sizimi-haze Fig. 16.

Gobius villosus Weber, 1909, p. 151; 1913, p. 466, fig. 92; Menado.

Marine goby known from Celebes and Japan.

Three specimens 40–55 mm; Siduura, Siduoka-ken.
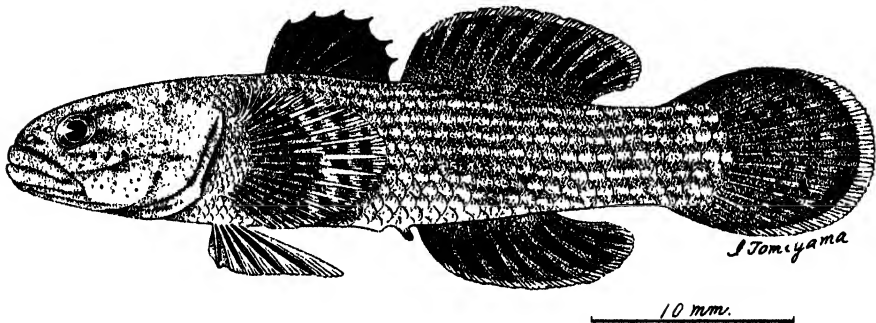
Fig. 16. *Gobius villosus* Weber.

31. *Gobius fuscus* Rüppell

Kumo-haze Fig. 17.

Gobius fuscus Rüppell, 1828, p. 137; Red Sea.
Gobius punctillatus Rüppell, 1828, p. 138; Red Sea. (*albopunctatus* Cuvier et Valenciennes in a later paper.)
Gobius soporator Cuvier et Valenciennes, 1837, p. 56; Martinique.
Gobius albopunctatus Cuv. et Val., 1837, p. 57; India.
Gobius nebulopunctatus Cuv. et Val., 1837, p. 58; Red Sea.
Gobius catulus Girard, 1858, p. 26, pl. 12, figs. 9 and 10; St. Joseph Island, Texas.
Gobius kreftii Steindachner, 1866, p. 451.
Gobius sandvicensis Günther, 1880, p. 60; Honolulu.
Gobius aelosoma Ogilby, 1889, p. 61 – Waite, 1904, p. 176. pl. 23, fig. 2; Lord Howe Island.
Gobius poecilichthys Jordan et Snyder, 1901, p. 52, fig. 4; Misaki, Kanagawa-ken.
Mapo crassiceps Jordan et Seale, 1906, p. 403. fig. 92; Apia. Cheeks tumid; whitish in spirits, with dusky wash, a small black dot just back of eye.
Mapo mearnsi Evermann et Seale, 1906, p. 510, fig. 2; Zamboanga, Mindanao. Greenish or greyish in spirits; sometimes very indistinct dusky markings appearing on middle line of side; no white dots.

See the synonyms given by McCulloch and Ogilby, 1919, p. 231, Meek and Hildebrand, 1928, p. 867, and Fowler, 1928, Fishes of Oceania, p. 405.

Marine goby. All seas of tropical and temparate zones.

More than one hundred specimens 25–90 mm; Misaki, Kanagawa-ken south to Kagosima; Ôsima and Hatizyô, Idu-siti-tô; Okinawa; coast near Tai-hoku, Formosa.

The specimens before me exhibit much variation in colour markings; the markings of *G. poecilichthys* given by Jordan and Snyder are commonest in Japan, and sometimes the markings almost fade away and a dark spot appears behind eye. Fourteen specimens 25–85 mm presented from the Leland Stanford Junior University Museum, labeled *Gobius soporator*, collected from La Paz Harbar in 1889 by U. S. Fish Commission Steamer "Albatross", well agree with Japanese specimens with the markings shown in Fig. 17, B.
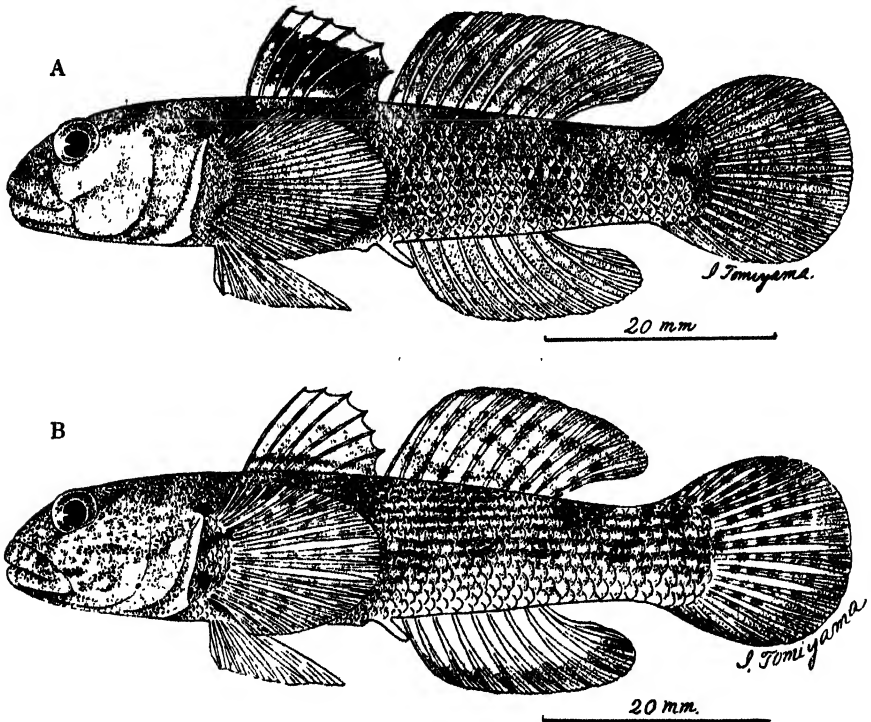
Fig. 17. *Gobius fuscus* Rüppell. A, an example from Simoda, Siduoka-ken. B, from Onna-mura, Okinawa.

32. *Gobius viganensis* Steindachner

Suzume-haze Fig. 18.

Gobius viganensis Steindachner, 1893, Ichth. Beitr., XVI, p. 230; Vigan, Philippins.

Marine and brackish water goby. Known from Philippines and Formosa.

Two specimens 50 and 55 mm; near Tainan, Formosa. The specimens before me have 6 dorsal spines; Steindachner has counted 7 ones.
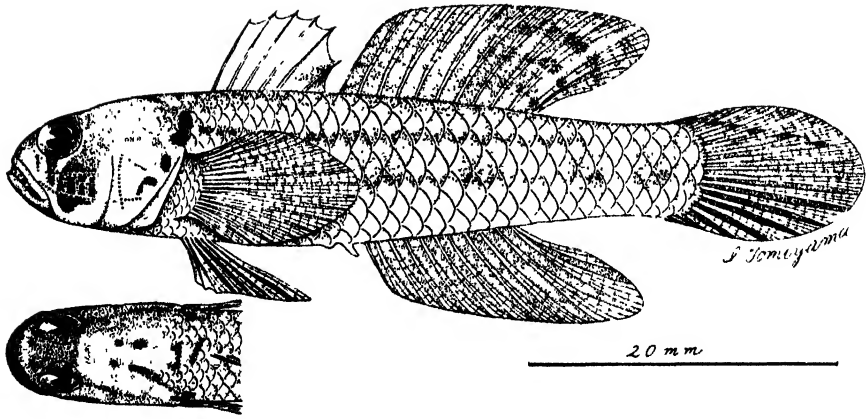
Fig. 18. *Gobius viganensis* Steindachner.

33. *Gobius neophytus* Günther

Sankaku-haze

Gobius neophytus Günther, 1875, p. 174, pl. 108, fig. E; Ponape; Huahine; Apia; Tahiti.
Rhinogobius muscarum Jordan et Seale, 1906, p. 401, fig. 90; Pago Pago. Young (Fowler).

Marine goby. Polynesia, west to Philippines and to Ryûkyû.

Single specimen 55 mm from Ryûkyû agrees well with the figure of *Rhinogobius neophytus* given by Jordan and Seale, 1906.

34. *Gobius macropteryx* (Franz)

Hirenaga-haze   Fig. 19.

Ctenogobius macropteryx Franz, 1910, p. 67, pl. 4, fig. 45; Dusi, Kanagawa-ken.

Marine goby known from Japan.

Single specimen 65 mm; Siduura, Siduoka-ken.
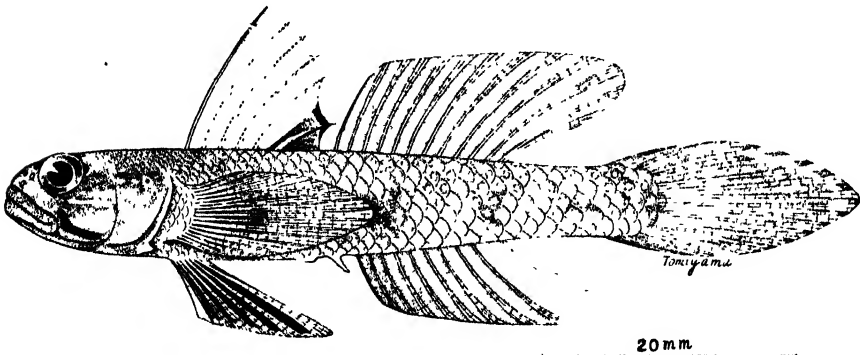
Fig. 19. *Gobius macropteryx* (Franz).

35. *Gobius lidwilli* McCulloch

Goma-haze Fig. 20.

Gobius lidwilli McCulloch, 1917, p. 185, pl. 31, fig. 2; Cowan Creek, near Sydney.

Marine goby known from New South Wales and Kôti-ken, Japan.

D. VI, I–6 or 7; A. I–5 or 6; V. I–5. Sq. l. 22; tr. a. 5; tr. b. 6. Head 3 in length, depth 4.5; snout 2.2 to 3 in head, eye 2.5, interorbital 3.5 to 4.5. Width of body below spinous dorsal origin 3/4 of depth; head gently depressed anteriorly; teeth in a few rows; tongue truncated anteriorly; lower end of gill-opening below middle of opercle. Scales ctenoid; head and belly naked. Colour in formalin white, with dark spots on head and posterior part of body; anterior half of spinous dorsal black.

Four specimens 12 mm collected by Mr. Toshiji Kamohara from Katasima, an islet of Kôti-ken.

The interorbital space of the specimens before me is a little broader than that described by McCulloch.
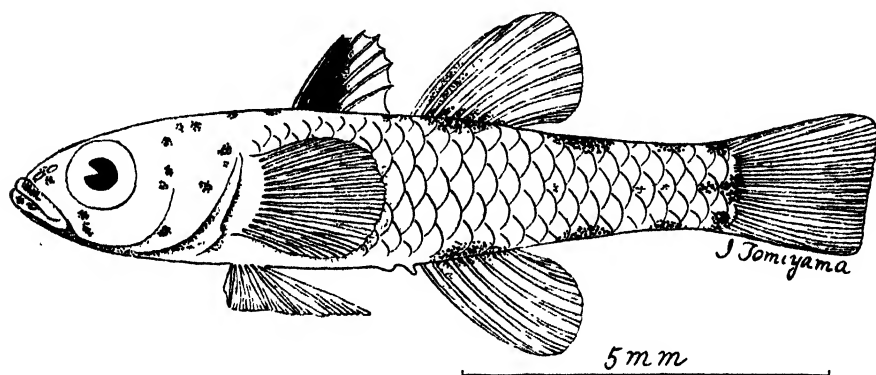
Fig. 20. *Gobius lidwilli* McCulloch.

This species is allied to *Pandaka pusilla* and *pygmaea* Herre, 1927, from Philippines, both described from the mature specimens respectively 13 to 16.5 mm and 7.5 to 11 mm in length, and distinguished from them in having the black blotch on the spinous dorsal and the naked belly.

36. *Gobius pflaumi* Bleeker

Suzi-haze

Gobius pflaumi Bleeker, 1853, Japan, p. 42, fig. 3; Nagasaki.

Gobius yokohamae Günther, 1877, p. 437; Yokohama Bay. The dark spot on lower angle of preoperculum is characteristic of *pflaumi*.

Gobius ophthalmoporus (nec Bleeker) Ishikawa et Matsuura, 1897, p. 39; Gyôtoku; Simoda; Tokyo. The specimens were re-examined and identified to *pflaumi* by Tanaka.

Ctenogobius virgatulus Jordan et Snyder, 1901, p. 63, fig. 9; Matusima to Nagasaki.

Rhinogobius suluensis Herre, 1927, p. 193, pl. 14, fig. 3; Bungau, Sulu Prov. Young.

Marine and brackish water goby. Japan; Korea; Philippines (*suluensis*, Herre); Nicobar(Kner).

Numerous specimens 30–80 mm; Kagosima north to Toyama Bay on the coast of Japan Sea and to Takenoura near Onagawa, Miyagi-ken, on the Pacific coast.

37. *Gobius gymnauchen* Bleeker
Hime-haze Fig. 21.

Gobius gymnauchen Bleeker, 1860, Japan, p. 84, pl. 1. fig. 2; Tokyo.
Rhinogobius baliuroides (nec Bleeker) Jordan et Richardson, 1908, p. 277; Aparri, Luzon.
Rhinogobius nebulosus (nec Forskål) Fowler, 1934, p. 82, fig. 23; Den Pasar, Bali. Second dorsal spine elongated.
Rhinogobius melanobranchus Fowler, 1934, p. 82, figs. 24 and 25; Den Posar, Bali. Black median band on ventral surface of head.
? *Gobius neilli* Day, 1868, p. 152; Madras. Nuchal region scaly; 2nd dorsal spine elongated.

Marine goby. Japan to Philippines; Siam.

Numerous specimens 30–100 mm; Unten, Okinawa north to Sakigata, Akita-ken, on the coast of Japan Sea and to the estuary of Abukuma River, Miyagi-ken, on the Pacific coast. The specimens before me are divided into two forms; one with the elongate second dorsal spine agrees well with the
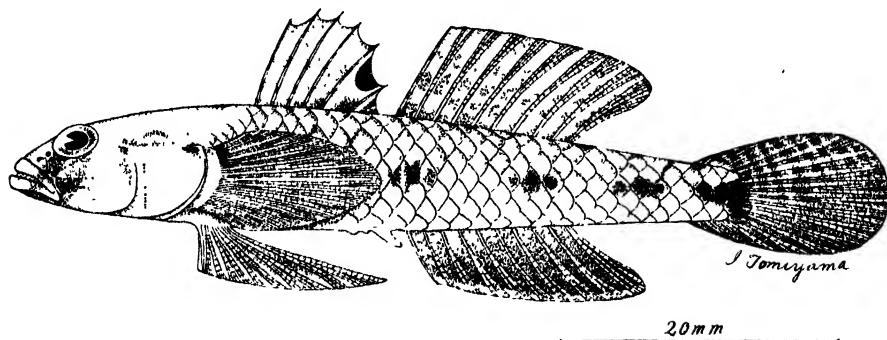
Fig. 21. *Gobius gymnauchen* (Bleeker).

figure given by Jordan and Snyder, 1901, and the other has no filamentous tips of dorsal spines as shown in Fig. 21. The differences of the form and markings of spinous dorsal are not correlated to the sexual differences and it seems to me that the form without filamentous dorsal spine is identical with *Rhinogobius baliuroides* (nec Bleeker) Jordan et Richardson and rather common in the sea of southern Japan. *Gobius baliuroides* Bleeker has very large eyes and is related to *Heteroplopomus barbatus* (Tomiyama).

38. *Gobius nebulosus* Forskål
Tumugi-haze

Gobius nebulosus Forskål, 1775, p. 24; Djidda, Red Sea.

Gobius criniger Cuvier et Valenciennes, 1837, p. 82; New Guinea; Malabar. Distinguished
from *nebulosus* by weaker canines.
Gobius brevifilis Cuv. et Val., 1837, p. 90; Pondicherry. Teeth in outermost row not larger.
Gobius atherinoides (Peters) Günther, 1861, p. 18. Depth is lower; referred to *criniger* by
Barnard, 1927.
Gobius petersii Steindachner, 1866, Ichth. Mittheil., IX, p. 781, pl. 18, fig. 7; Zanzibar. (*G.
caninus* (nec Cuv. et Val.) Steindachner in a later paper.)
Gobius caninus var. *africana* Playfair, 1866, p. 71, pl. 9, fig. 1; Zanzibar.
Gobius caninus (nec Cuv. et Val.) Steindachner, 1867, Ichth. Not., VI, p. 313; Cape York.
(Identified to *caninus* var. *africana* Playfair.)
Gobius auchenotaenia Bleeker, 1874, Madagascar, p. 56, pl. 18, fig. 1; Madagascar. Young.
*Gobius festivus De Vis, 1884, p. 687. Referred to *nebulosus* by McCulloch and Ogilly.
Rhinogobius lungi Jordan et Seale, 1907, p. 41, fig. 13; Panay. Young.
Rhinogobius baliuroides (nec Bleeker) Fowler, 1934, fig. 127; Den Fasar, Bali. Young.

Marine and brackish water goby. Red Sea, East Africa, India, East
Indies, Australia and north to Ryûkyû.

Three specimens 70–150 mm; Naze, Amami-Ôsima; Jolo, Philippines. The
specimens before me agree with the figure of *Gobius caninus* var. *africana*
given by Playfair and that of *Rhinogobius lungi* by Jordan and Seale.

39. *Gobius giurinus* Rutter

Gokuraku-haze

Gobius giurinus Rutter, 1897, p. 86; Swatow, China.
Ctenogobius hadropterus Jordan et Snyder, 1901, p. 60, fig. 7; Nagasaki; Kurume; Turuga;
Kawatana. Young.

Fresh water goby. South China north to Japan and Korea.

Numerous specimens 30–120 mm; Japan south of Tiba-ken; Ryûkyû;
Formosa.

40. *Gobius similis* (Gill) Jordan et Snyder

Yosinobori   Fig. 22.

?? *Rhinogobius similis* Gill, 1859, p. 145; Simoda.
Gobius similis Jordan et Snyder, 1900, p. 372; Isikawa-ken. (*Ctenogobius similis* in a later
paper.)
Ctenogobius similis Jordan et Snyder, 1901, p. 759, pl. 35; Tusima.
Rhinogobius nagoyae Jordan et Seale, 1906, p. 147, fig. 5; Nagoya. Nuchal region naked;
5 brown bars on side of body.
Ctenogobius kurodai Tanaka, 1908, p. 32; Tokyo. (*similis* Jordan et Snyder in a later paper.)
Size of mature male and female smaller.
Ctenogobius katonis Tanaka, 1908, p. 35; Isikawa-ken. (*similis* Jordan et Snyder in a later
paper.)
Ctenogobius canditianus Regan, 1908, p. 153; Lake Candidius, Formosa.
Ctenogobius bedfordi Regan, 1908, p. 62, pl. 2, fig. 1; Chon-ju, Korea. Tips of dorsal spines
produced in filaments.
Rhinogobius carpenteri Seale, 1909, p. 533; Trinidad River, Baguio. Philippine form; head,
nuchal region, pectoral base and median stripe behind ventrals naked (Herre, 1927).
Rhinogobius sowerbyi Ginsburg, 1917, p. 100; Yalu River. Belly naked.
Rhinogobius taiwanus Oshima, 1919, p. 300, pl. 53, fig. 1; Sintiku and several other localities
of Formosa.

Rhinogibius formosanus Oshima, 1919, p. 300, pl. 53, fig. 2; Sintiku, Formosa.

Rhinogobius fluviatilis Tanaka, 1925, Fishes of Japan, vol. 34, p. 641, pl. 151, figs. 417 and 418; Himeji.

Tukugobius bucculentus Herre, 1927, p. 121, pl. 8, fig. 4; Santa Fé, Nueva, Vizcaya Prov. and several other localities of Philippines. Philippine form with 7 dorsal spines and longitudinal stripe along middle of side.

Tukugobius philippinus Herre, 1927, p. 124; Irid River, Santa Ines, Rizal Prov. and several other localities of Philippines. Philippine form with 6 or 7 dorsal spines and dark brown or blackish coloration.

Rhinogobius similis lindbergi Berg, 1933, p. 654, fig. 612; Amur River. Nuchal region naked.

Rhinogobius fukushimae Mori, 1934, p. 55, pl. 21, fig. 2; Pei-ho at Ko-pei-ku. Dorsals greatly apart; longitudinal blackish streak on side of body.

Rhinogobius aestivaregia Mori, 1934, p. 56, pl. 21, fig. 3; Summer Palace of Johol. Six large blotches on side of body.

Fresh water goby. Hokkaidô south to Formosa; Korea; Manchuria; Philippines.

Colour in formalin pale to dark; when darkest, body and fins concolorous with pale narrow edges on vertical fins; in other cases coloration much variable.

This goby is a polymorphic species.

Numerous specimens 20–120 mm; Hokkaidô to Formosa; Korea.

The specimens before me not so well agree with the description of *Rhinogobius similis* Gill which somewhat suggests *Gobius giurinus* Rutter. Gill has described " This species would answer quite well to the description of *Gobius*
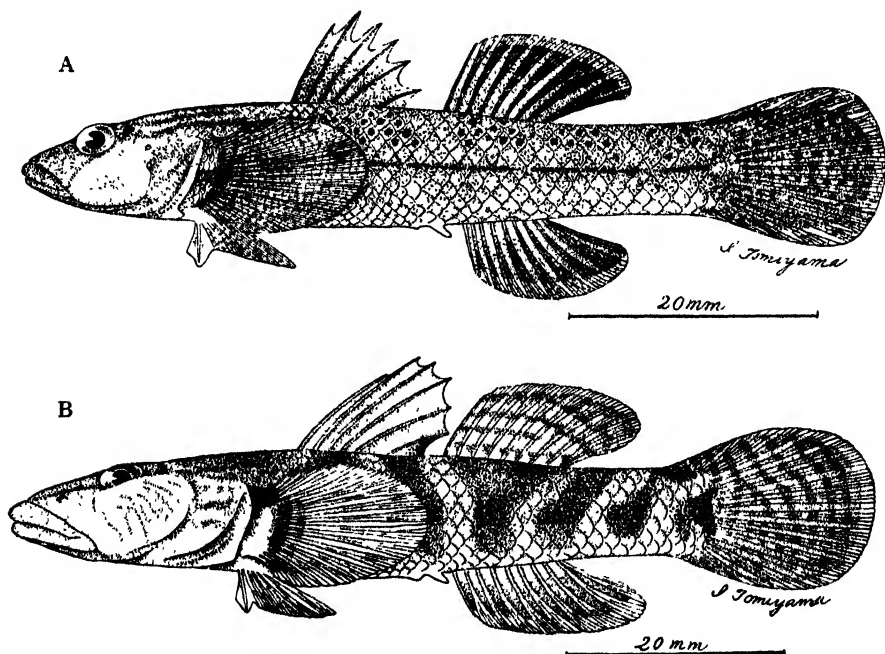
Fig. 22. *Gobius similis* Jordan et Snyder. A, an example with smaller head and dark spots on body. B, with larger head and dark cross bands.

pflaumi of Bleeker, were it not for the elongation of the head ", and Bleeker has described " vertice squamoso " on *G. pflaumi* and drawn the scales on the occiput which extend to the eye.

41. *Gobius caninus* Cuvier et Valenciennes

Hokuro-haze

Gobius caninus Cuvier et Valenciennes, 1837, p. 86; Java.
Coryphopterus bernadoui Jordan et Starks, 1905, p. 207, fig. 9; probably from Korea. Scales 25 in longitudinal series.
Rhinogobius similis (nec Gill) Smith, 1931, p. 43; Bandon Bight, Gulf of Siam. Young.
Rhinogobius simulans Smith, 1931, Copeia, p. 64. Name *similis* altered in *simulans*.

Marine and brackish water goby. East Indies, South China and north to Ryûkyû ; Korea ?
Five specimens 75–110 mm ; Tainan, Formosa ; Hainan, China.

42. *Gobius viridipunctatus* Cuvier et Valenciennes

Kirara-haze

Gobius viridipunctatus Cuvier et Valenciennes, 1837, p. 62; Bombay.
Gobius chlorostigma Bleeker, 1849, Blenn. en Gob., p. 27; Batavia; Surabaya; Kammel. Type 165 mm, probably a larger example.

Marine and brackish water goby. India, East Indies and north to Ryûkyû.
Three specimens 115–125 mm ; Ryûkyû.

43. *Gobius masoni* Day

Kobire-haze

Gobius masoni Day, 1873, p. 107; 1889, pl. 61, fig. 6; Bombay.

Marine and brackish water goby known from Bombay and Formosa.
Single specimen 90 mm ; Tainan Market, Formosa.

44. *Gobius tessellata* (Herre)

Hina-haze

Vaimosa tessellata Herre, 1927, p. 153, pl. 12, fig, 1; Titunod River at Kolambugan, Lanao Prov., Mindanao.

Marine and brackish water goby. Philippines and Japan.
Two specimens 30 mm ; Miyamura, Yaku-sima, Kagosima-ken ; Unten, Okinawa. In the specimens before me the spinous dorsal fin has several jet-black spots near the margin.

45. *Gobius validus* (Jordan et Seale)

Kasumi-haze Fig. 23.

Greisson validus Jordan et Seale, 1907, p. 43, fig. 16; Cavite.

Marine goby. Philippines and Japan.

Single specimen 60 mm, probably from Misaki, Kanagawa-ken. The specimen before me somewhat differs from the description by Jordan and Seale in having very narrow interorbital space and some different markings especially on the caudal fin.
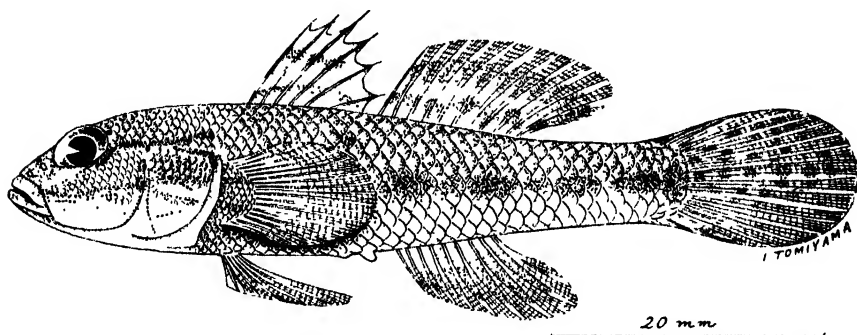
Fig. 23. *Gobius validus* (Jordan et Seale).

46. *Gobius puntang* Bleeker

Inko-haze

Gobius puntang Bleeker, 1851, Riouw, p. 486, Rhio. Young.
Gobius puntangoides Bleeker, 1853, Ceram, p. 242; Amboina; Wahai, Ceram.
Gobius andamanensis Day, 1870, p. 691; Andamans. (*puntang* in a later paper.)
Gobius maculipinnis Macleay, 1883, p. 267; Normandy Island, D'Entrecasteux Group. Referred to *puntang* by McCulloch and Ogilby, 1919, p. 221.
Gobius concolor De Vis, 1884, p. 689; Cape York. Referred to *puntang* by McCulloch and Ogilby, 1919, p. 221.
Gnatholepis sindonis Snyder, 1908, p. 101; 1912, p. 513, pl. 68, fig. 1; Naha, Okinawa. Young.

Marine and brackish water goby. Andamans, Queensland north to Ryûkyû.

Five specimens 70–150 mm; Yaeyama Islands, Ryûkyû; Jolo, Philippines.

47. *Gobius otakii* (Jordan et Snyder)

Yukata-haze

Hazeus otakii Jordan et Snyder, 1901, p. 51, fig. 3; Nagasaki.

Marine and brackish water goby known from Japan.

Seven specimens 50–60 mm; Katuyama, Tiba-ken; Siduura, Siduoka-ken; Nagasaki.

48. *Gobius knighti* (Jordan et Evermann)
Ômon-haze   Fig. 24.

. *Gnatholepis knighti* Jordan et Evermann, 1903, p. 204; Hiro.
?! *Gnatholepis thompsoni* Jordan, 1904, p. 541, pl. 1, fig. 2; Tortugas Archipelago.

Marine and brackish water goby. Polynesia, Philippines and Japan.

Two specimens 40 and 50 mm; Hatizyô-zima, Idu-siti-tô. All the characters of the specimens before me except narrower interorbital space almost quite agree with those of *G. thompsoni* Jordan.
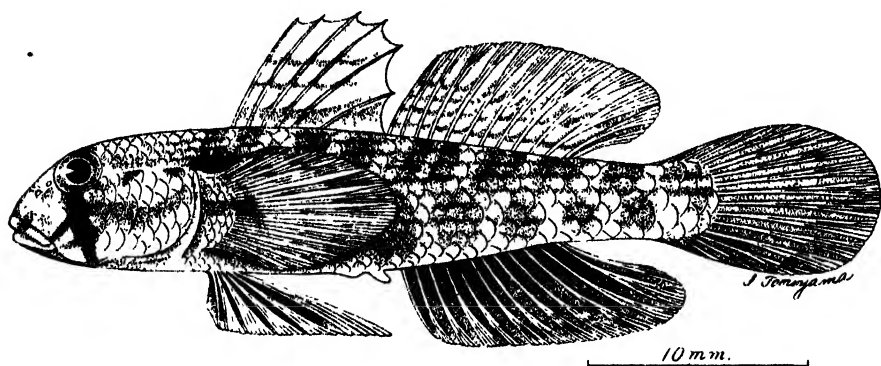
Fig. 24. *Gobius knighti* (Jordan et Evermann).

19a.   *Gobius ornatus ornatus* Rüppell
Kazari-haze

Gobius ornatus Rüppell, 1828, p. 135; Massaua, Red Sea.— Snyder, 1912, p. 442; Tanega-sima, Kagosima-ken.
Gobius ventralis Cuvier et Valenciennes, 1837. p. 113; Massaua. Referred to *ornatus* by Günther.
Gobius interstictus Richardson, 1844, p. 3, pl. 5, figs. 3–5; north-west coast of Australia. Types re-examined by Günther.
Gobius periophthalmoides Bleeker, 1851, Blenn. et Gob., p. 249; West Sumatra. (*ornatus* in a later paper.)
Gobius (Istigobius) stephensoni Whitley, 1932, p. 301; Low Isles. Queensland form.

Marine goby. Red Sea, India, East Indies, Australia, Polynesia and north to Japan.

Three specimens 50–60 mm; Philippines. No Japanese specimens at hand.

49b.   *Gobius ornatus campbelli* (Jordan et Snyder)
Kutuwa-haze

Ctenogobius campbelli Jordan et Snyder, 1901, p. 62, fig. 8; Wakanoura, Wakayama-ken.
Gobius calderae Evermann et Seale, 1907, p. 511, fig. 3; Caldera Bay, Mindanao.

Rhinogobius decoratus Herre, 1927, p. 181, pl. 13, fig. 3; Cabalian Leyte. D. VI, I-8; A.
  I-8; scales 26 to 28; a black ocellus on spinous dorsal.
?*Gobius elegans* (nec Kuhl et Hasselt) Bleeker, 1851, Blenn. et Gob., p. 243, fig. 10; Java.
  Name and figure only.

Marine goby. Japan south to East Indies.

Twenty three specimens 30–90 mm; Misaki, Kanagawa-ken; Simoda,
Siduoka-ken; Siduura, Siduoka-ken; Nagasaki; Onna-mura, Okinawa and some
other islands of Ryûkyû; South Sea. Japanese specimens before me have
rather obscure markings and agree well with the description of *C. campbelli*
Jordan et Snyder, and the specimen from South Sea has very distinct markings
as described by Herre on *Rhinogobius calderae*, and the markings of those from
Ryûkyû are not so distinct as those of the specimen from South Sea.

Rhinogobius decoratus Herre has less numerous scales and rays of dorsal
and anal fins.

49c.   *Gobius ornatus hoshinonis* (Tanaka)

Hosino-haze   Fig. 25.

Rhinogobius hoshinonis Tanaka, 1917, p. 226; Hiro, Arita-gun, Wakayama-ken.
?!*Rhinogobius honkongensis* Seale, 1914, p. 74, pl. 1, fig. 2; Hongkong.

Marine goby known from Japan.

D. VI, I-10; A. I-10; V. I-5. Sq. l. 29; tr. a. 8; tr. b. 9; tr. c. 6;
pred. 18.

Single specimen 85 mm; Nagasaki.

The figure of *R. hongkongensis* given by Seale shows some similar mark-
ings on head and body; on the same type Seale has counted 25 scales in a
longitudinal series, while Herre 35 ones in a longitudinal series and 10 ones
in front of the spinous dorsal origin.
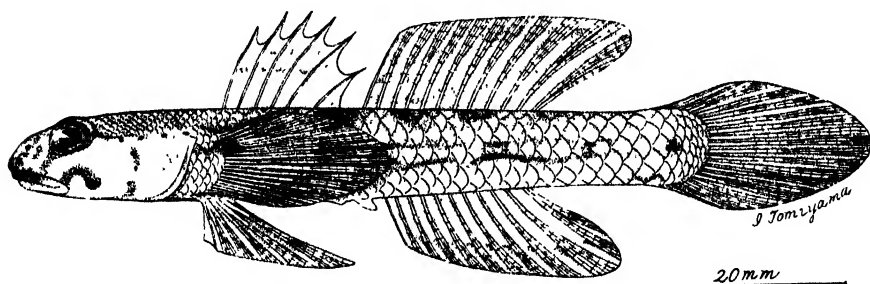
Fig. 25. *Gobius ornatus hoshinonis* (Tanaka).

49d.   *Gobius ornatus masago* form. nov.

Masago-haze   Fig. 26.

Marine goby, known from coast of Tiba-ken.

D. VI-7; A. I-7; V-5. Sq. l. 28, tr. a. 9; tr. b. 10; tr. c. 4; pred. 8.

Head 4 in length, depth 5; snout 3.5 in head, eye 3.5, maxillary 3; inter-orbital 3 in eye. Anterior part of body slightly compressed; nostrils without tube; teeth in several rows. Pectoral without free rays. Scales on side of body ctenoid; those on occiput not reaching eye; breast scaly. Colour in formalin after long preservation brownish above, paler below, with series of dark spots along middle of side of body; scales on upper part of body edged with dark; opercle with a dark blotch.
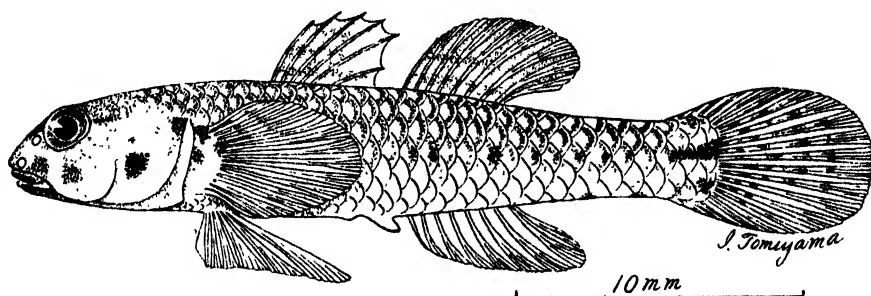
Fig. 26. *Gobius ornatus masago.* Type.

Type, No. 30228, Science Faculty Museum, 30 mm; coast of Tiba-ken. Cotype 25 mm; Tokyo market.

This goby is distinguished from other forms of *Gobius ornatus* by its smaller head and fewer rays of dorsal and anal fins.

50. *Gobius abei* (Jordan et Snyder)
Abe-haze

Ctenogobius abei Jordan et Snyder, 1901, p. 55, fig. 5; Wakanoura, Wakayama-ken.
Tamanka bivittata Herre, 1927, p. 224, pl. 17, fig. 4; Haihow, Hainan, China.

Marine and brackish water goby sometimes found in fresh water. Japan; Ryûkyû; South China.

Twenty-two specimens 25–60 mm; Namerikawa, Toyama-ken; Tokyo; River Ara near Tokyo; Kanazawa near Yokohama; Lake Hamana; Himedi; Hirosima; Ariake Sound; Nisibaru, Okinawa.

51. *Gobius tagara* (Herre)
Hôguro-haze

Glossogobius parvus Oshima, 1919, p. 305, pl. 53, fig. 3; Kizanto; Giran, Formosa.
Tamanka tagara Herre, 1927, p. 222; Malabon, Rizal Prov.; Sitankai.
?! *Gobius platystoma* Günther, 1871, p. 664, pl. 63, fig. B; Port Mackay, North-eastern Australia. Scales 60; no markings on body and fins.

Probably marine and brackish water goby. Philippines; Formosa.

Two specimens 40 and 45 mm; Tainan, Formosa.

The figure of *Glossogobius parvus* given by Oshima is very characteristic

but the author has counted 41 scales in longitudinal series. The name *Gobius parvus* is a homonym of an American species.

Genus 23. *Awaous* Cuvier et Valenciennes

Awaous Cuvier et Valenciennes, 1837, p. 97 (*Gobius ocellaris* Broussonnet).
Chonophorus Poey, 1860, p. 274 (*C. bucculentus* Poey).
Trichopharynx Ogilby, 1898, p. 769 (*Gobius crassilabris* Günther).

52. *Awaous ocellaris* (Broussonnet)
Minami-haze

Gobius ocellaris Broussonnet, 1782, fig. 142; Tahiti.— Cuvier et Valenciennes, 1837, p. 98; Mauritius. Spinous dorsal with 2 black spots.
Gobius pallidus Cuv. et Val., 1873, p. 102, Mauritius. Probably larger example with spinous dorsal coloured scarcely with black.
Gobius guamensis Cuv. et Val., 1873, p. 103; Guam. No black blotch on spinous dorsal.
Gobius stamineus Eydoux et Souleyet, 1841, p. 179; Hawaii. No black spots on spinous dorsal.
Gobius melanocephalus Bleeker, 1849, Blenn. en Gob., p. 34; Bogowonto River, Purworedjo. (*personatus* in a later paper.)
Gobius personatus Bleeker, 1849, Blenn. en Gob., p. 34; Seraiju River, Banjumas. No black spots on spinous dorsal.
Gobius grammeopomus Bleeker, 1849, Blenn. en Gob., p. 34; Bogowonto River, Purworedjo. (*personatus* in a later paper.)
Gobius crassilabris Günther, 1861, p. 63; Oualan; Aneiteum. Spinous dorsal with longitudinal series of brown dots.
Gobius litturatus Steindechner, 1861, p. 289, figs. 4 and 5.
Euctenogobius striatus Day, 1868, p. 272, fig; Madras. No black spots on spinous dorsal.
Gobius jayakari Boulenger, 1887, p. 663, pl. 55, fig. 2; Muscat. East Arabian form with smaller scales, about 65 in longitudinal series; no black spots on spinous dorsal.
?*Gobius nigripinnis* Cuv. et Val., 1837, p. 101; Réunion. Head and all fins black or blackish.

Fresh water goby. Mauritius, Arabia, India, East Indies, Polynesia and to Ryûkyû.

Five specimens 130–155 mm ; Amami-Ôsima ; Taihoku, Formosa. The specimens before me have no black spots on spinous dorsal fin and agree with the figure of *G. crassilablis* given by Günther and that of *Chonophorus ocellaris* by Tanaka, 1928, Fishes of Japan, vol. 42, pl. 173, fig. 478. It seems that the maxillary becomes long with age, and extends to below posterior margin of eye in larger individuals.

Genus 24. *Stenogobius* Bleeker

Stenogobius Bleeker, 1874, Syst. Nat. Gob., p. 317 (*Gobius gymnopomus* Bleeker).
Oligolepis Bleeker, 1874, Syst. Nat. Gob., p. 317 (*Gobius melanostigma* Bleeker).
Apparius Jordan et Richardson, 1908, p. 278 (*Gobius acutipinnis* Cuvier et Valenciennes).

Key to Japanese species of *Stenogobius*

　a. Scales 25 to 30; 5 dark large blotches along middle of side of body, and smaller ones between them .... *acutipinnis*
　aa. Scales 50 to 55; about 12 dark cross bands on body .... *genivittatus*

53. *Stenogobius acutipinnis* Cuvier et Valenciennes
Nobori-haze

Gobius acutipinnis Cuvier et Valenciennes, 1837, p. 80; Malabar.
Gobius setosus Cuv. et Val., 1837, p. 81; Pondicherry. No blotches on side of body.
?*Gobius melanostigma* Bleeker, 1849, Blenn. en Gob., p. 32; Batavia. Colour very dark.
?*Rhinogobius ocyurus* Jordan et Seale, 1907, p. 42, fig. 14; Cavite. No dark band below
    eye described nor drawn.

Marine and brackish water goby. East Africa, India, East Indies and
north to Ryûkyû.

Single specimen 50 mm; Miyako-zima, Ryûkyû. Eight specimens 60–90
mm; Philippines. The specimen from Ryûkyû has smaller head than those
from Philippines.

54. *Stenogobius genivittatus* Cuvier et Valenciennes
Tane-kawa-haze

Gobius genivittatus Cuvier et Valenciennes, 1837, p. 64; Tahiti.
Awaous genivittatus Snyder, 1912, p. 442; Tanegasima, Kagosima-ken.
Gobius polyzona Bleeker, 1874, Madagascar, p. 55, pl. 17, fig. 1; Samberano River. Figure
    very characteristic.

Fresh water goby. Madagascar, East Indies, Polynesia and north to Japan.
Thirteen specimens 75–115 mm; Basilan, Philippines. No Japanese speci-
mens at hand.

Genus 25. *Amblygobius* Bleeker

*Amblygobius Bleeker, 1874, Syst. Nat. Gob., p. 322 (*Gobius sphynx* Cuvier et Valenciennes).
*Odontogobius Bleeker, 1874, Syst. Nat. Gob., p. 323 (*Gobius bynoensis* Richardson).

Key to Japanese species and forms of *Amblygobius*

a. Dorsal rays VI, I–14 or 15; scales 55 to 60; 5 cross bands on side of body..
                                                                semicinctus
   b. Cross bands with dark borders .... *semicinctus semicinctus*
   bb. Cross bands without dark borders .... *semicinctus sphynx*

55a. *Amblygobius semicinctus semicinctus* (Bennett)
Sarasa-haze   Fig. 27.

*Gobius semicinctus Bennett, 1833, p. 32; Mauritius.— Günther, 1861, p. 68 (type
    of Bennett). Young.
Gobius papilio Cuvier et Valenciennes, 1837, p. 91; Mauritius. Young.
Gobius phalaena Cuv. et Val., 1837, p. 92; Vanicoro, Santa Cruz Archipelago.
*Gobius annulatus De Vis, 1884, p. 688; Cape York. Referred to *phalaena* by McCulloch
    and Ogilby.

Marine goby. Mauritius, Queensland, East Indies, Polynesia and north to
Ryûkyû.

Four specimens 70–130 mm ; Unten, Okinawa ; Tokunosima, Ryûkyû ; Jolo, Philippines.
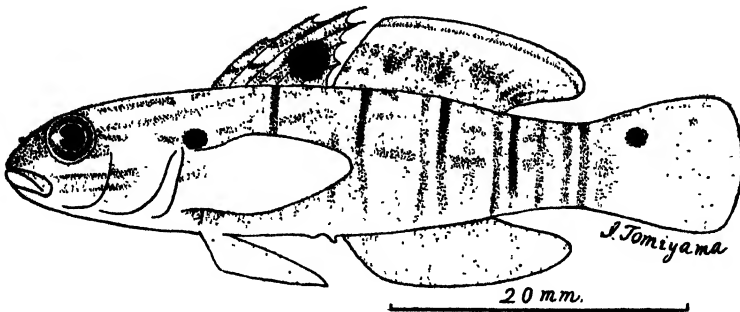
Fig. 27. *Amblygobius semicinctus semicinctus* (Bennett). Young.

55b. *Amblygobius semicinctus sphynx* (Cuvier et Valenciennes)
Hûrai-haze

Gobius sphynx Cuvier et Valenciennes, 1837, p. 93; New Guinea.
Amblygobius sphinx Jordan et Richardson, 1909, p. 201; Takao, Formosa.

Marine goby. East Indies north to Formosa.
No specimens at hand.

Genus 26. *Waitea* Jordan et Seale

Waitea Jordan et Seale, 1906, p. 407 (*Gobius mystacinus* Cuvier et Valenciennes).

56. *Waitea mystacina* (Cuvier et Valenciennes)
Kasuri-haze Fig. 28.

Gobius mystacinus Cuvier et Valenciennes, 1837, p. 124; Java.
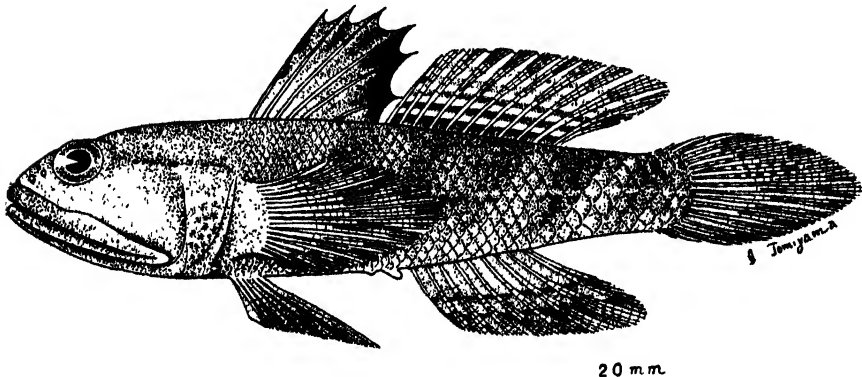
Fig. 28. *Waitea mystacina* (Cuvier et Valenciennes).

Gobius maxillaris Macleay, 1878, p. 358, fig. 2; Port Darwin.
Waitea maxillaris McCullock et Ogilby, 1919, p. 250, pl. 35, fig. 3.   Macleay's type; colour
    completely faded.
Waitea parvida Tanaka, 1915, p. 567; Nagasaki.

Marine goby.   Polynesia, North Australia and north to Japan.

Colour in formalin brownish, with several oblique bands on body; opercle
dotted with dark specks; spinous dorsal with dark blotch posteriorly.

Three specimens 35–50 mm; Nagasaki; the smallest one is the type of
W. parvida Tanaka.

According to Koumans' description, 1931, p. 67, two specimens of *Gobius
mystacinus* Cuv. et Val., collected by Kuhl and v. Hasselt in Java have some
different characters from those described by Cuvier and Valenciennes.

Genus 27.   *Oxyurichthys* Bleeker

Oxyurichthys Bleeker, 1860, Celebes, p. 44 (*Gobius belosso* Bleeker).
Gobiichthys Klunzinger, 1871, p. 479 (*Apocryptes petersii* Klunzinger).
Pselaphias Jordan et Seale, 1906, p. 406 (*Gobius ophthalmonema* Bleeker).

Key to Japanese species of *Oxyurichthys*

a. Dorsal rays VI, I–12; anal rays I–13
    b. Scales 55 to 60
        c. Ocular tentacle lacking
            d. Breast naked; 4 obscure blotches on side of body.................*saru*
            dd. Breast scaly; scales on upper part of body with small dark round spots
                                                                              microlepis
        cc. Ocular tentacle present......................................*tentacularis*
    bb. Scales 75 to 80; 6 large blotches on side of body, and obscure ones below
            spaces between preceding ones............................. *papuensis*

57.   *Oxyurichthys saru* sp. nov.
Saru-haze   Fig. 29.

?? *Oxyurichthys amabalis* Seale, 1914, p. 76, pl. 2, fig. 1; Hongkong.

Marine goby known from Siduura, Siduoka-ken.

D. VI, I–12; A. I–13; V. I–5.   Sq. l. 55 to 60; tr. a. about 20; tr.
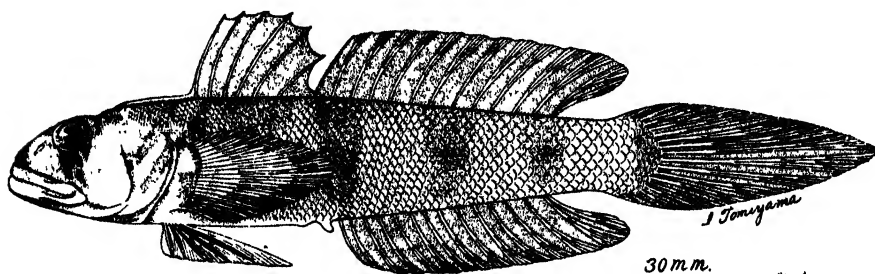
Fig. 29. *Oxyurichthys saru*.   Type.

b. about 25; tr. c. 5 or 6; pred. 16 to 18. Head 3.5 in length, depth 5 to 5.5; snout 3 in head, eye 4, maxillary 2; interorbital 2.5 to 3 in eye. Width of body below spinous dorsal origin 3/5 of depth; teeth in 1 row in upper jaw, in 3 rows in lower jaw. Scales on nape not extending beyond anterior end of naked dermal median ridge on occiput; head, breast, and pectoral base naked. Colour in formalin after long preservation brownish grey, with 4 obscure blotches on side of body; a dark blotch below eye; opercle crossed by 2 diagonal obscure bands; vertical fins darker; ventrals blackish.

Type, No. 30522, Science Faculty Museum, and cotype 110 mm; Siduura, Siduoka-ken.

This species is allied to *O. amabalis* Seale and from which distinguished in having smaller scales and the different markings on the head and body.

58. *Oxyurichthys microlepis* (Bleeker)

Tategami-haze

Gobius microlepis Bleeker, 1849, Blenn. en Gob., p. 35; Sumanap, Madura.
Euctenogobius cristatus Day, 1873, p. 109; 1899, pl. 57, fig. 8; Bombay.

Marine and brackish water goby. India, Java north to Japan.

Three specimens 70–110 mm; Kôti. Two specimens 95 and 100 mm; Manila. The obscure ocellus on pectoral base of the specimens before me is irregular in form, larger than that shown in the figure of *Gobius cristatus* by Day, and sometimes almost obsolete.

59. *Oxyurichthys tentacularis* (Cuvier et Valenciennes)

Matuge-haze

Gobius tentacularis Cuvier et Valenciennes, 1837, p. 128, Java. — Bleeker, Java, p 434; Batavia; Surabaya; Kammal.
Gobius macrurus Bleeker, 1849, Blenn. en Gob., p. 35; Batavia; Surabaya. (*tentacularis* in a later paper.)
Gobius ophthalmonema Bleeker, 1856, Ternate, p. 208; Ternate.
Oxyurichthys viridis Herre, 1927, p. 260; Manila Market; Nabalas, Guimares Island; Capiz, Panay. Young.

Marine and brackish water goby. Burma to Society Islands and Formosa.

Two specimens 125 and 130 mm; Tansui River, Formosa. The specimens before me have the caudal contained 3 times in the total length as in *Gobius tentacularis* by Bleeker, and 5 obscure blotches on side of body as described by the same author on *ophthalmonema*.

60. *Oxyurichthys papuensis* (Cuvier et Valenciennes)

Nanban-haze

Gobius papuensis Cuvier et Valenciennes, 1837, p. 106; New Guinea.
Oxyurichthys papuensis Jordan et Richardson, 1909, p. 201; Takao Formosa.

Gobius petersenii Steindachner, 1893, Ichth. Beitr., XVI, p. 234; Swatow, China.
Gobionellus lonchotus Jenkins, 1904, p. 503, fig. 44; Honolulu.

Marine and brackish water goby. East Indies, Australia, Polynesia and north to Formosa.

Single specimen 45 mm; Jolo, Philippines. The specimen before me agrees well with the description of *Gobius petersenii* Steindachner and *Gobionellus lonchotus* Jenkins. No Japanese specimens at hand.

Genus 28. *Cryptocentrus* (Ehrenberg) Bleeker

*Cryptocentrus (Ehrenberg Ms.) Bleeker, 1874, Syst. Nat. Gob., p. 322; 1876, Oxyurichthys etc., p. 142 (*Gobius cryptocentrus* Cuvier et Valenciennes).
*Paragobioides Bleeker, 1874, Syst. Nat. Gob., p. 322 (*Gobius knutteli* Bleeker).

Key to Japanese species of *Cryptocentrus*

a. Dorsal rays VI, I–10 or 11; anal rays I–9 to 11
    b. Scales 70; breast and belly scaly; cross bands on body extending on anal..
                                                   octafasciatus
    bb. Scales 70 to 85; breast and belly naked; row of black irregular spots ex-
        tending from upper part of opercle to upper part of caudal peduncle....
                                                   yatsui
    bbb. Scales more than 85
        c. Body compressed; jet-black spot on spinous dorsal near its origin .. *filifer*
        cc. Body cylindrical, very dark.. *oni*
aa. Dorsal rays VI, I–13 to 15; anal rays I–14 to 16; scales 90; 5 broad cross
    bands on body .... *fontanesi*

61. *Cryptocentrus octafasciatus* Regan
Takanoha-haze   Fig. 30.

Cryptocentrus octafasciatus Regan, 1908, p. 241, pl. 29, fig. 2; Chagos Archipelago.

Marine goby known from Chagos Archipelago and Hirosima.
D. VI, I–10; A. I–9; V. I–5. Sq. l. 70; tr. a. 20; tr. b. 30. Head 3 in length, depth 4.5; snout 4 in head, eye 4.5, maxillary 2.5; interorbital very
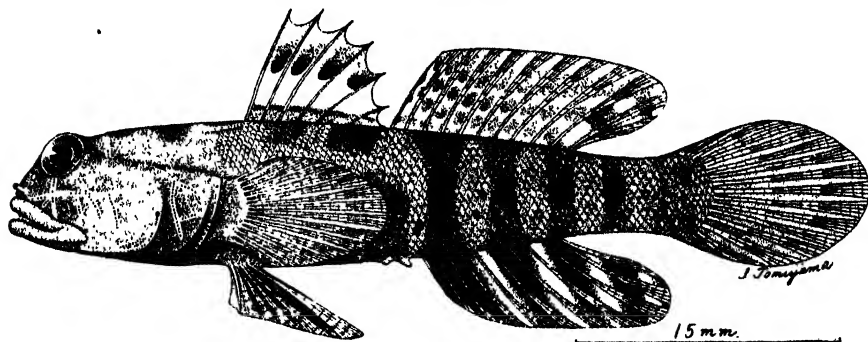
Fig. 30. *Cryptocentrus octafasciatus* Regan.

narrow. Width of body below spinous dorsal 3/5 of depth; head compressed; teeth in several rows; these in outermost row larger; outermost row of lower jaw restricted anterior third of the jaw with a large canine-like tooth at end; these in innermost row of lower jaw especially several ones near angle of mouth larger; tongue truncate. Scales on side of body ctenoid, becoming cycloid anteriorly; breast scaly; head, nuchal region and pectoral base naked. Colour in formalin grey, with dark cross bands on side of body, 4 of which on posterior half of body extending on anal; dark small ocelli scattered on lower half of body; small pale round spots scattered on head; dorsals with dark spots.

Single specimen 50 mm; Hirosima. The round spots on the head are smaller than those figured by Regan.

62. *Cryptocentrus yatsui* sp. nov.
Yatu-haze Fig. 31.

Probably marine and brackish water goby known from Formosa.

D. VI, I-10 or 11; A. I-9 or 10; V I-5. Sq. l. 75 to 85; tr. a. about 25. Head 3.5 in length, depth 5 to 6; snout 4 to 4.5 in head, eye 6 to 7, interorbital 8 to 9.5, maxillary 2.5. Anterior part of body nearly cylindrical; teeth in several rows; these in outermost and innermost rows larger; outermost row of lower jaw restricted on anterior part of the jaw, with 1 or 2 large canine-like teeth at its end; tongue rounded anteriorly; a low but stout fleshy ridge on inner margin of shoulder girdle. Tip of 2nd dorsal spine elongated in filament. Scales on body cycloid; head and neck naked back to

2 0 mm
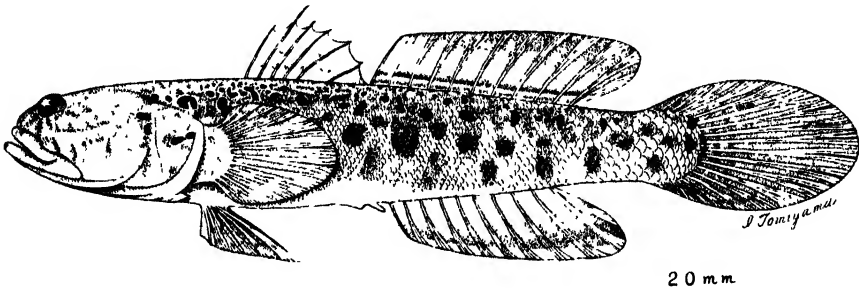
Fig. 31. *Cryptocentrus yatsui.* Type.

soft dorsal; pectoral base and belly also naked. Colour in formalin brownish above, paler below; head and dorsal part of body mottled with darker dots; row of black irregular spots extending from upper part of opercle to upper part of caudal peduncle; about 20 dark spots arranged in 2 rows along side of body; fins greyish.

Type, No. 25229, Science Faculty Museum, 90 mm and six cotypes 65–80 mm; Tainan Market, Formosa.

This species is allied to *Cryptocentrus gobioides* (Ogilby) of Australia from which it is distinguished by the absence of the dermal median ridge on the occiput and the different markings on the fins.

I take pleasure in naming this species in honor of Dr. N. Yatsu.

63. *Cryptocentrus filifer* (Cuvier et Valenciennes)
Itohiki-haze

Gobius filifer Cuvier et Valenciennes, 1837, p. 106; India. No black spot on spinous dorsal described.
Gobius knutteli Bleeker, Japan, p, 16, pl, 1, fig. 1; Nagasaki.

Marine and brackish water goby. India, South China north to Japan and Korea.

Numerous specimens 50–150 mm; coast near Sibata, Niigata-ken; Toyama Bay; Tokyo Market; coast of Siduoka-ken south to Ariake Sound, Kyûsyû; Taihoku and Tainan, Formosa. In some of the specimens before me the white spots on the posterior half of soft dorsal fin and upper part of caudal fin are replaced by black spots.

64. *Cryptocentrus oni* sp. nov.
Oni-haze   Fig. 32.

Marine goby, known from Prov. Idu, Siduoka-ken.

D. VI, I–11; A. I–11; V. I–5. Sq. l. about 100; tr. a. about 25; tr. c. about 30; tr. c. about 10; pred. more than 12. Head 3.5 in length, depth 8; snout 5 in head, eye 4.5, maxillary 2.5; interorbital very narrow. Body

30 mm
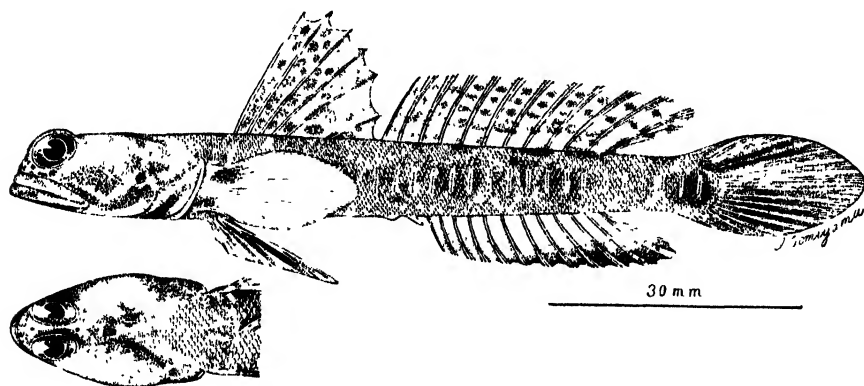
Fig. 32. *Cryptocentrus oni*. Type.

cylindrical; teeth in several rows; tongue acutely rounded. Scales small, cycloid; head naked; nuchal region, breast and pectoral base scaly. Colour in formalin after long preservation purplish dark, pale on belly, with large dark blotches on side of body; black band on lower part of opercle extending

forward to tip of chin ; dorsals with dark round spots ; caudal and anal dusky ; ventrals blackish ; pectoral pale ; 2 dark blotches on pectoral base.

Type, No. 21898, Science Faculty Museum, 120 mm ; Prov. Idu, Siduoka-ken.

This species is distinguished from other species belonging to the same genus by the peculiar form of head as shown in the figure.

65. *Cryptocentrus fontanesi* (Bleeker)
Kizi-haze   Fig. 33.

Gobius fontanesii Bleeker, 1852, Celebes, p. 764; Bulucumba.

Marine goby.   East Indies north to Japan.
Single specimen 105 mm ; Kagosima-ken.
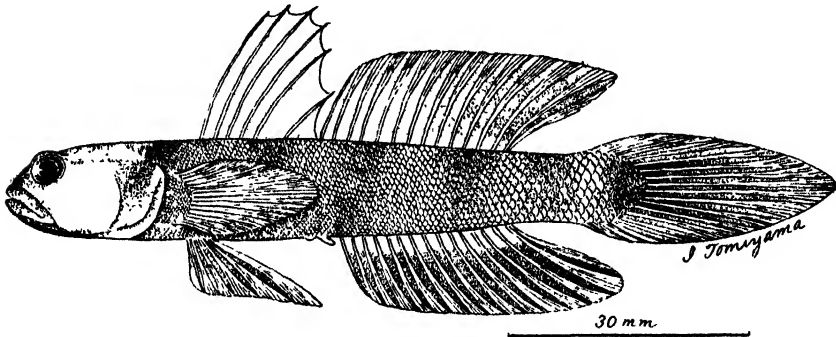
Fig. 33.   *Cryptocentrus fontanesi* (Bleeker).

Genus 29.   *Callogobius* Bleeker

Callogobius Bleeker, 1874, Syst. Nat. Gob., p. 318 (*Eleotris hasseltii* Bleeker).
Doryptena Snyder, 1908, p. 102 (*D. okinawae* Snyder).
Macgregorella Seale, 1909, p. 533 (*M. moroana* Seale).
Mucogobius McCulloch, 1912, p. 93 (*Gobius mucosus* Günther).
Galera Herre, 1927, p. 103 (*Galera producta* Herre).
Gunnamatta Whitley, 1928. p. 225 (*Gunnamatta insolita* Whitley).

Key to Japanese species of *Callogobius*

a. Scales about 40; ventral sucker bilobed posteriorly, with rudimental anterior fraenum . . . .*hasselti*
aa. Scales more than 70; ventral sucker oblong, with well developed anterior fraenum . . . . :. *tanegasimae*

66.   *Callogobius hasselti* (Bleeker)
Okinawa-haze

Eleotris hasseltii Bleeker, 1851, Blenn. en Gob., p. 253, fig. 13; Anjer, Java.

Gobius mucosus Günther, 1871, p. 663, pl. 63, fig. A; Adelaide. Scales not counted; figure very characteristic.

*Gobius depressus Ramsay et Ogilby, 1886, p. 4. Referred to *G. mucosus* Günther by Waite.

Doryptena okinawae Snyder, 1908, p. 103; 1912, p. 513, pl. 67, fig. 2; Naha Okinawa.

Macgregorella intonsa Herre, 1927, p. 100, pl. 7, fig. 2; near Saub, Cotabato Prov., Mindanao.

Gunnamatta insolita Whitley, 1928, p. 225, pl. 16, fig. 3; Gunnamatta Bay, Port Hacking, New South Wales. Jaws with broad bands of long curved canines which are not depressible.

Mucogobius gobiosoma Whitley, 1931, p. 326. New name for *Callogobius hasseltii* var. *mucosus* McCulloch et Ogilby and for *Gobius depressus* Ramsay et Ogilby.

Marine goby. Australia north to Ryûkyû.

Seven specimens 30–50 mm; Naha; Onna-mura, Okinawa; Jaluit, Marshall Islands. The specimens before me with caudal fin bilobed posteriorly agree well with the description of *D. okinawae* Snyder and *M. intonsa* Herre.

67. *Callogobius tanegasimae* (Snyder)

Tane-haze

Doryptena tanegasimae Snyder, 1908, p. 104; 1912, p. 442, pl. 59, fig. 2; Tanegasima; Akune, Kagosima-ken.

Galera producta Herre, 1927, p. 104, pl. 7, fig. 3; Puerto Galera. Uniform yellowish brown in spirits, dermal ridges on head blackish.

Marine goby known from Japan and Philippines.

Single specimen 70 mm; Yaku-sima, Kagosima-ken. The specimen has about 75 scales in a longitudinal series. Snyder has counted 57 scales but drawn about 70 scales.

Genus 30. *Acanthogobius* Gill

Acanthogobius Gill, 1859, p. 145 (*Gobius flavimanus* Temminck et Schlegel).

*Synechogobius Gill, 1862, p. 46 (*Gobius hasta* Temminck et Schlegel).

Aboma (nec Jordan et Starks) Jordan et Snyder, 1901, p. 67 (*Gobius lactipes* Hilgendorf).

?*Aboma* Jordan et Starks, 1895, p. 497 (*A. etheostoma* Jordan et Starks).

Key to Japanese species of *Acanthogobius*

a. Dorsal spines 7 to 12 (usually 8 or 9); anterior fraenum of ventral sucker with fringed margin

 b. Scales 35 to 40; head naked .... *lactipes*

 bb. Scales 55 to 75; top and sides of head scaly

   c. Soft dorsal rays I-12 to 14; caudal peduncle slightly shorter than soft dorsal base .... *flavimanus*

   cc. Soft dorsal rays I-18 to 20; caudal peduncle shorter than half length of soft dorsal base .... *hasta*

68. *Acanthogobius lactipes* (Hilgendorf)

Asi-siro-haze

*Gobius lactipes Hilgendorf, 1878, p. 109; Tokyo.

Aboma lactipes Jordan et Snyder, 1900, p. 372; 1901, p. 67, fig. 10, Matusima; Aomori; Tokyo; Turuga; Enosima; River Tone.

Aboma tsushimae Jordan et Snyder, 1901, p. 759; 1901, p. 69, fig. 11; Sasuna, Tusima. Young with dorsal spines not elongated in filaments.

Marine and brackish water goby. Japan; Korea; Sou-chow, China (Jordan et Hubbs).

Twenty-one specimens 50–90 mm; Usu, Hokkaidô; Lake Hatirô-gata; Akita; Namerikawa, Toyama-ken; Kesen, Iwate-ken; Arahama, Miyagi-ken; Lake Kasumiga-ura; Ariake Sound. Some of the specimens before me have dorsal spines not elongated in filaments.

69. *Acanthogobius flavimanus* (Temminck et Schlegel)

Ma-haze

Gobius flavimanus Temminck et Schlegel, 1845, p. 141, pl. 74, fig. 1; Nagasaki.

Gobius stigmathonus Richardson, 1845, p. 147; Canton. Chinese form with velvet-black mark on upper half of spinous dorsal.

Aboma snyderi Jordan et Fowler, 1902, p. 575, fig.; Aomori. Young.

Marine and brackish water goby. Japan, Korea and China.

D. VIII or IX, I–12 to 14; A. I–11; V. I–5. Sq. l. 55 to 65; tr. a. 14 to 18; tr. b. 20 to 28; tr. c. 9 to 13; pred. 25 to 30. When chin dusky, ventral sucker dark and anal and caudal edged with black as described by Jordan and Starks on *A. stigmothinus* from Husan, Korea, 1905. Sometimes dots on the spinous dorsal united in a few larger jet-black spots on posterior part of the fin.

Numerous specimens 40–250 mm; Aomori to Kagosima; Tôrai, Keisyô-nan-dô, Korea.

70. *Acanthogobius hasta* (Temminck et Schlegel)

Hazekuti

Gobius hasta Temminck et Schlegel, 1845, p. 144, pl. 75, fig. 1; Japan.

Gobius ommaturus Richardson, 1845, p. 146, pl. 55, figs. 1–3; Woosung; Canton. Chinese form probably based on an individual before spawning.

Fresh and brackish water goby. Ariake Sound and Yatusiro Sound, Japan; Korea; Formosa; China; Java (Kner, 1865).

Numerous specimens 40–460 mm; Ariake Sound, Kyûsyû. One specimen 230 mm; near Keizyô, Korea.

Genus 31. *Pterogobius* Gill

Pterogobius Gill, 1864, p. 266 (*Gobius virgo* Temminck et Schlegel).

Key to Japanese species and forms of *Pterogobius*

    a. Dorsal rays VIII, I–19 to 21; scales 75 to 80; inner margin of shoulder girdle
        smooth .. .. *elapoides*

   b. Snout shorter than 1/3 length of head; 6 or 7 pale narrow cross bands
      on side of body .... *elapoides zonoleucus*
  bb. Snout as long as 1/3 length of head at least; 6 or 7 dark cross bands
      on side of body................................... *elapoides elapoides*
aa. Dorsal rays VIII, I–24 to 27; scales more than 100; a fleshy ridge on inner
     margin of shoulder girdle; upper part of both opercle and preopercle scaly
  c. Five dark broad cross bands on side of body..................... *zacalles*
  cc. A pale longitudinal band on body bordered with dark above and below....
                                                         virgo

71a. *Pterogobius elapoides zonoleucus* Jordan et Snyder

Tyagara

Pterogobius zonoleucus Jordan et Snyder, 1901, p. 94, fig. 19; Misaki, Kanagawa-ken.

Marine goby, known from Japan and Korea.

Numerous specimens 30–90 mm; Toyama Bay; Tiba-ken to Nagasaki.
The ventral sucker of larger individuals is very dark.

71b. *Pterogobius elapoides elapoides* (Günther)

Kinubari

Gobius elapoides Günther, 1871, p. 665, pl. 63, fig. D; Japan.
Pterogobius daimio Jordan et Snyder, 1901, p. 91, fig. 17; Misaki, Kanagawa-ken; Wakano-
   ura, Wakayama-ken.

Marine goby. Japan and Korea; St. John's Island, 90 miles east of
Hongkong (Smitt, 1896).

Numerous specimens 40–110 mm; Saitu, Amakusa, Kumamoto-ken north
to Takenoura, near Onagawa, Miyagi-ken on the Pacific coast and to Tobi-
sima, an islet of Yamagata-ken, on the coast of Japan Sea.

    See the note on the variation of *P. elapoides* given by Tanaka, 1931,
" On the distribution of fishes in Japanese waters " p. 5, pl. 3.

72. *Pterogobius zacalles* Jordan et Snyder

Ryûgû-haze

Pterogobius zacalles Jordan et Snyder, 1901, p. 93, fig. 18; Misaki, Kanagawa-ken.

Marine goby known from Japan.

Sixteen specimens 40–150 mm; Tôni Bay, Iwate-ken; Tokyo Market;
Misaki and Hudisawa, Kanagawa-ken; Toyama Bay; Nagasaki.

73. *Pterogobius virgo* (Temminck et Schlegel)

Nisiki-haze   Fig. 34.

Gobius virgo Temminck et Schlegel, 1845, p. 143, pl. 74, fig. 4; Nagasaki.

Marine goby known from Japan.

Numerous specimens 25–165 mm ; Toyama Bay ; Misaki, Kanagawa-ken ; Wakayama-ken ; Nagasaki.
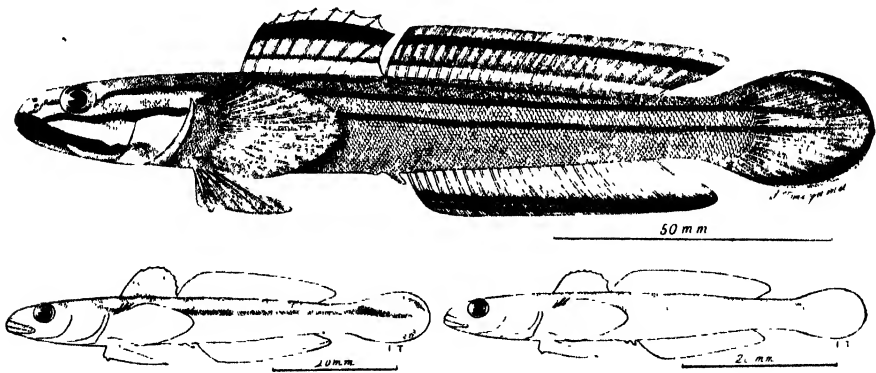
Fig. 34. *Pterogobius virgo* (Temminck et Schlegel).

Genus 32. *Glossogobius* Gill.

Glossogobius Gill, 1862, p. 46 (*Gobius platycephalus* Richardson).
Cephalogobius Bleeker, 1874, Syst. Nat. Gob., p. 320 (*Gobius sublitus* Cantor).

Key to Japanese species and forms of *Glossogobius*

a. Dorsal rays VI, I-9 or 10; anal rays I-8 or 9; scales 30 to 35
  b. Gill-membranes united across isthmus; upper iris making small projection into pupil . . . . *biocellatus*
  bb. Gill-membranes attached to isthmus; more than 20 scales before spinous dorsal . . . . *giuris*
    c. Black specks scattered on occiput and dorsal part of body . . *giuris brunneus*
    cc. No black specks on head and body . . . . *giuris giuris*

74. *Glossogobius biocellatus* (Cuvier et Valenciennes)

Hitomi-haze

Gobius biocellatus Cuvier et Valenciennes, 1837, p. 73; Pondicherry.
Gobius sublitus Cantor, 1849, p. 1163; Pinang.— Günther, 1861, p. 24. Cantor's type; skin; not good state; 38 scales counted.
Glossogobius vaisiganis Jordan et Seale, 1906, p. 403; fig. 93; Vaisigano River at Apia; Pago Pago. Vomer toothed.
Glossogobius abacopus Jordan et Richardson, 1909, p. 200, pl. 74; Takao, Formosa. Vomer and palatine toothed.— Jordan et Tanaka, 1927, p. 247; Udonsiki, Ryûkyû.

Marine and fresh water goby. India, Polynesia, Queensland north to Ryûkyû.

Eight specimens 65–90 mm ; Philippines ; Hainan, China. The specimens before me have no teeth on the vomer and palatine. No Japanese specimens at hand.

In *Glossogobius abacopus* Jordan et Richardson the vomer and palatine

are toothed and the ventral sucker is checkered and its authors gave no description on the pupil and gill-membranes.

75.   *Glossogobius giuris brunneus* (Temminck et Schlegel)
Uro-haze   Fig. 35.

Gobius brunneus Temminck et Schlegel, 1845, p. 142, pl. 74, fig. 2; Nagasaki.
Gobius olivaceus Temminck et Schlegel, 1845, p. 142, pl. 74, fig. 3; Japan. On a drawning by Burger; referred to *brunneus* by Jordan and Snyder, 1901.
Gobius fasciato-punctatus Richardson, 1845, p. 145, pl. 62, figs. 13 and 14; Canton. Figures very characteristic.
Gobius giurus (nec Hamilton) Rutter, 1897, p. 85; Swatow. Referred to *brunneus* by Jordan and Richardson, 1908.

Marine and brackish water goby.   Japan; Formosa; South China.

Numerous specimens 35–205 mm; Simidu, Siduoka-ken south to Kawanabe, Kagosima-ken; Tainan, Formosa; Hainan, China.   The youngest specimen from Ariake Sound has the characteristic dark specks on the back.
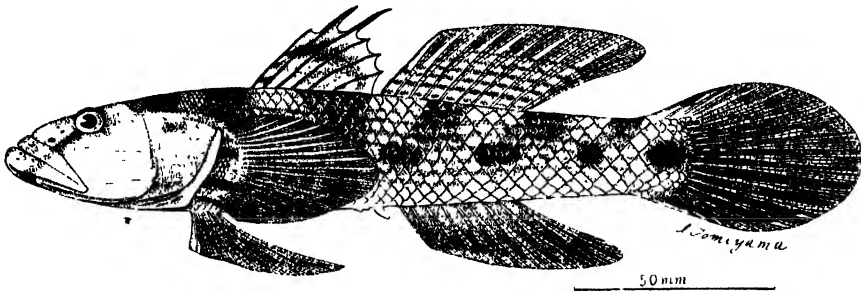
Fig. 35.   *Glossogobius giuris brunneus* (Temminck et Schlegel).

75b.   *Glossogobius giuris giuris* (Hamilton)
Hutago-haze   Fig. 36.

Gobius giuris Hamilton, 1822, p. 51, pl. 33, fig. 15; Gangetic Provinces.
Gobius gutum Hamilton, 1822, p. 50; lower parts of the Padda or Padma River. Abnormal form of *giuris* (Hora, 1934).
Gobius kokius Cuvier et Valenciennes, 1837, p. 68, Mauritius; Malabar; Pondicherry.
Glossogobius kokius Hora, 1924, p. 493; Singgora, Tale Sap. Marine form.
Gobius russelii Cuv. et Val., 1837, p. 75; Pondicherry.
Gobius catebus Cuv. et Val., 1837, p. 76; Rangoon; Pondicherry; Bengal; Malabar.
Gobius kora Cuv. et Val., 1837, p. 77; Coromandel. On Russel's figure.
Gobius platycephalus Richardson, 1846, p. 204; Macao. On Reeve's drawing.
Gobius spectabilis Günther, 1861, p. 45; India. A large example with elongate caudal fin.
Gobius circumspectus Macleay, 1883, p 267; Milne Bay, Papua.
Glossogobius circumspectus McCulloch et Ogilby, 1919, p. 235; Milne Bay, Papua. Second dorsal spine filamentous.
Glossogobius giurus var. *obscuripinnis* (Peters, 1868) Herre, 1927, p. 164; Lake Buhi and Lake Bato, Camarines, Sur Prov.
Glossogobius koragensis Herre, 1935, p. 419; Koragu, Spec River, and Ambot, Kerame River, New Guinea. A form with shorter paired-fins.

Marine and brackish water goby. East coast of Africa, India, East Indies, Queensland, Polynesia, South China and north to Formosa.

Single specimen 135 mm; Tainan Formosa. I have compared this specimen with the thirteen Philippine ones 55–165 mm with larger eye.
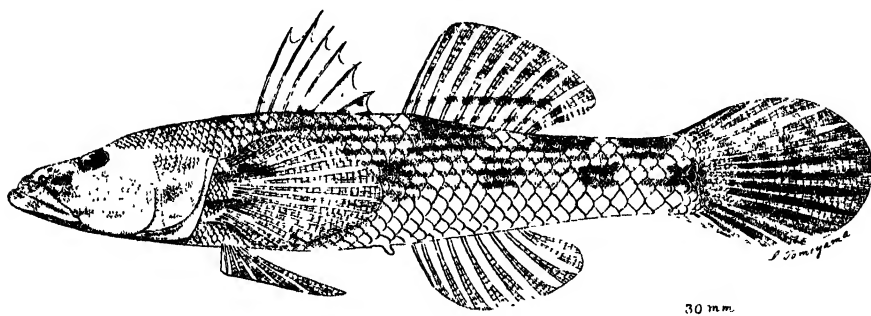
Fig. 36. *Glossogobius giuris giuris* (Hamilton).

Genus 33. *Chaenogobius* Gill

Chaenogobius Gill, 1862 (*Gobius annularis* Gill).
Gymnogobius Gill, 1863, p. 269 (*Gobius macrognathos* Bleeker).
Chloea Jordan et Snyder, 1901, p. 78 (*Gobius castaneus* O'Shaughnessy).

Key to Japanese species and forms of *Chaenogobius*

a. Lower jaw slightly projected anteriorly
  b. Anal rays I-8 to 11
    c. Dorsal and ventral parts of body naked....................*macrognathus*
    cc. Dorsal part of body scaly.....................................*annularis*
      d. Interorbital width as large as diameter of eye in adult..............
          annularis annularis
      dd. Interorbital width larger than diameter of eye in adult..............
          annularis urotaenia
  bb. Anal rays I-12 or 13........................ .. ..*heptacanthus*
    e. Scales 70 to 75............................*heptacanthus heptacanthus*
    ee. Scales 90 to 100 ....*heptacanthus murorana*
aa. Lower jaw included............................ ....*cylindricus*

76. *Chaenogobius macrognathus* (Bleeker)

Edo-haze   Fig. 37.

Gobius macrognathos Bleeker, 1860, Japan, p. 83, pl. 2, fig. 1; Edo (Tokyo).

Marine and brackish water goby known from Tokyo.

D. V to VII (usually VI), I-11 or 12; A. I-9 or 10; V. I-5. Sq. l. 49 to 53. Head 3.5 to 4 in length, depth 6 to 7; snout 3 to 3.5 in head, eye 5 to 6, maxillary 1.7 to 1.8; interorbital 2 to 3 in eye. Body slightly compressed; head depressed; cheeks tumid; maxillary extending far behind

angle of mouth; paired pores on interorbital space not close together. Scales not closely arranged, hardly visible with naked eye, weakly ctenoid on caudal peduncle and becoming cycloid anteriorly; head and dorsal and ventral parts of body naked. Colour in formalin greyish, with vermiculation on dorsal part of head and body, and with several obscure cross bars on side of body; anal dark below, edged with pale or not; ventral sucker dark.
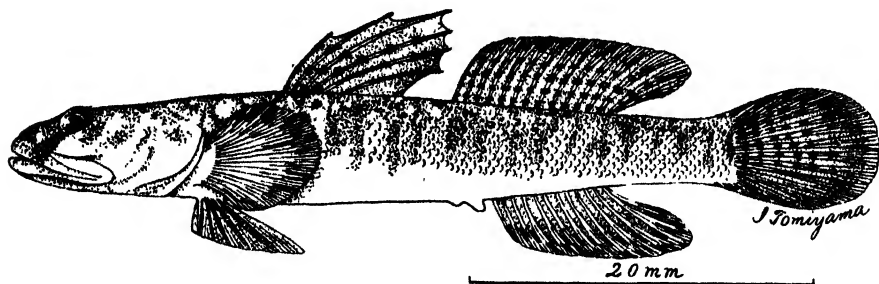
Fig. 37. *Chaenogobius macrognathus* (Bleeker).

More than seventy specimens 40–55 mm; Haneda and a vicinity of Tokyo.

As Koumans has noted, *Chaenogobius macrognathos* (nec Bleeker) Jordan et Snyder is not identical with Bleeker's description of *macrognathos*. See the remarks on *C. annularis urotaenia* (Hilgendorf).

77a.   *Chaenogobius annularis annularis* (Gill)

Biringo

*Gobius annularis Gill, 1859, p. 12; Hakodate.— Günther, 1861, p. 65; scales cycloid; ocelli near vent. After Gill.
Gobius castaneus O'Shaughnessy, 1875, p. 145; Nagasaki. Anal and ventrals dark-coloured or darker towards their extremities.
Gobius laevis Steindachner, 1879, Ichth. Beitr., VIII, p. 20; Hakodate. (Suggested to be identical with castaneus.)
Gobius breunigii Steindachner, 1879, Ichth. Beitr., VIII, p. 22; Hakodate. Scales 60 to 62.
Chloea nakamurae Jordan et Richardson, 1907, p, 265, fig. 13; Nagaoka. Vertical fins, ventrals and branchiostegals black.
Chloea senbae Tanaka, 1916, p. 228; Senba-numa, Ibaraki-ken. A series of black dots along middle of side of body; 8 yellowish cross bands on side.*

Fresh and brackish water goby. Saghalien to Kyûsyû; Korea.

D. VI to VIII, I–8 to 10; A. I–8 to 10; V. I–5. Sq. l. 60 to 80; tr. a. 15 to 21; tr. b. 18 to 25; tr. c. 0 to 13; pred. 0 to 20. Scales on side of body ctenoid; nuchal region naked or scaly; head, pectoral base and breast naked; naked area behind ventral base sometimes extending to vent.

Numerous specimens 30–90 mm; Hakodate to Nagasaki-ken. The specimens before me exhibit much variation in every character, especially in the form of body which varies in the specimens not only collected from different localities but also from the same locality at the same time, and in the squamation

and in the coloration.   When gill-membranes, dorsals, anal and ventrals are black, sometimes small dark ocelli appear around vent as described by Gill.

77b.   *Chaenogobius annularis urotaenia* (Hilgendorf)
Ukigori   Fig. 38.

Gobius urotaenia Hilgendorf, 1879, p. 108; Tokyo.   Young.
Aboma urotaenia Jordan et Snyder, 1901, p. 71.   After Hilgendorf.
Chaenogobius macrognathos (nec Bleeker) Jordan et Snyder, 1901, p. 76, fig. 3; Hunaki,
    Siga-ken; Kurume; Aomori; Tokyo; Turuga; Titose; Matubara; Same; Gihu; Nagoya.
Chloea aino Schmidt, 1904, p. 207; Arakal River, Lake Tunaitchi, Saghalien.   Referred to
    C. macrognathos (nec Bleeker) Jordan et Snyder by Berg.
Chaenogobius isaza Takana, 1916, p. 102; Lake Biwa.   Form of Lake Biwa with lower
    depth of caudal peduncle and obscure markings.

Fresh water goby.   Saghalien to Amami-Ôsima; Korea north to Vladivostok; North China (Berg).

D. VI or VII, I–10 or 11 rarely 12; A. I–10 or 11; V. I-5.   Sq. l. 75 to 90; tr. a. 20 to 25; tr. b. 25 to 35; tr. c. 17 to 20; pred. 25 to 35. Maxillary in larger individuals extending to below midway between eye and posterior margin of preopercle when longest.

Numerous specimens 35–140 mm; Hidaka, Hokkaidô south to Kawanabe, Kagosima-ken; Ranan, Korea.   Type of *Chaenogobius isaza* Tanaka, 60 mm and many cotypes from deeper water of Lake Biwa.
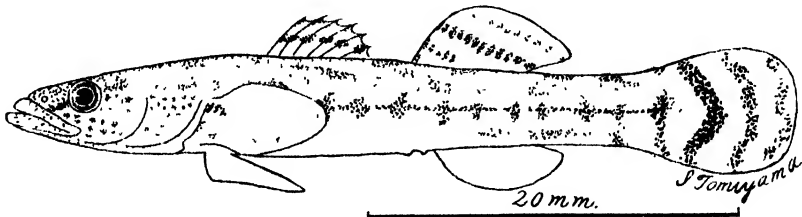
Fig. 38.   *Chaenogobius annularis urotaenia* (Hilgendorf).   Young.

The scales on side of body of younger individuals with colour markings identical with those described by Hilgendorf become cycloid with age but those on the caudal peduncle remain weakly ctenoid.

Chaenogobius, *Gymnogobius* or *Chloea macrognathos* (nec Bleeker) by Japanese, American and Russian ichthyologists is adult of *urotaenia* and not identical with Bleeker's description of *macrognathos*.

78a.   *Chaenogobius heptacanthus heptacanthus* (Hilgendorf)
Niku-haze

Gobius heptacanthus Hilgendorf, 1879, p. 110; Tokyo Bay.

Aboma heptacanthus Jordan et Snyder, 1901, p. 70. After Hilgendorf.
Chloea sarchynnis Jordan et Snyder, 1901, p. 82, fig. 15; Wakanoura, Wakayama-ken. Young.

Marine and brackish water goby, known from Japan and Korea.

Numerous specimens 30–65 mm, Misaki, Kanagawa-ken south to Nagasaki. Larger individuals have a large black blotch with a pale margin below on the posterior part of spinous dorsal fin.

78b. *Chaenogobius heptacanthus murorana* (Jordan et Snyder)

Hebi-haze

Chloea mororana Jordan et Snyder, 1901, p. 80, fig. 14; Muroran; Hakodate.
Chloea bungei Schmidt, 1931, p. 119, fig. 5; Seikosin, Korea. Scales 85.

Marine and brackish water goby. Japan and Korea.

Thirteen specimens 45–70 mm; Tisima?; Muroran; Matukawaura, near Nakamura, Hukusima-ken; coast of Ibaraki-ken or Tiba-ken. In some of the specimens before me the ventral and anal fins and the gill-membranes are dark as described by Schmidt on *bungei*.

79. *Chaenogobius cylindricus* sp. nov.

Kiseru-haze   Fig. 39.

Probably marine goby, known from Hirosima.

D. VI, I–11; A. I–10; V. I–5. Sq. l. 80; tr. a. 18; tr. b. 21. Head 4 in length; depth 7; snout 4 in head, eye 5.5, interorbital 8.5, maxillary 2. Anterior part of body cylindrical; head depressed; teeth villiform, on band; these in outermost row of upper jaw larger; tongue notched anteriorly; inner margin of shoulder girdle with a low fleshy ridge. Paired pores on posterior part of interorbital space close together. Scales cycloid; head, nape, breast, belly and pectoral base naked. Colour in formalin brownish dark, with darker mottles; ventrals and anal blackish.
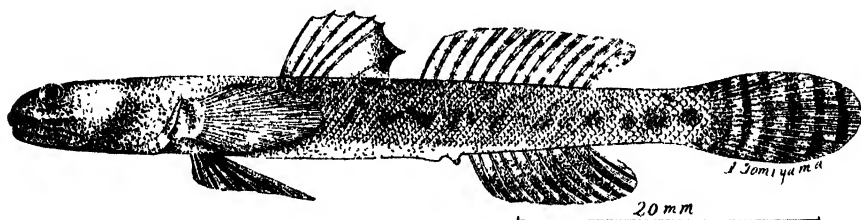
Fig. 39. *Chaenogobius cylindricus.* Type.

Type, No. 30389, Science Faculty Museum, 55 mm; Hirosima.

This species is distinguished from other species belonging to the same genus by its slender body and included lower jaw.

Genus 34. *Chasmichthys* Jordan

*Saccostoma (Guichenot Ms.) Sauvage, 1882, p. 171 (*S. gulosum* (Guichenot Ms.) Sauvage). Preoccupied.
Chasmias Jordan et Snyder, 1901, p. 761 (*C. misakius* Jordan et Snyder). Preoccupied.
Chasmichthys Jordan, 1901, p. 941. Replaced for *Chasmias*.

Key to Japanese formes of *Chasmichthys dolichognathus*

   a. Scales 70 to 80; black speckes scattered on side of body......*dolichognathus*
   aa. Scales 85 to 90; no black specks on body........................*gulosus*

80a. *Chasmichthys dolichognathus dolichognathus* (Hilgendorf)
Ago-haze

Gobius dolichognathus Hilgendorf, 1879, p. 108; Tokyo
Chasmias dolichognathus Jordan et Snyder, 1901, p. 84; fig. 16; Hakodate to Nagasaki.

Marine goby. Hakodate to Tanegasima; Korea.
Numerous specimens 20–70 mm; Kagosima north to Niigata on the coast of Japan Sea and to Kesen, Iwate-ken, on the Pacific coast; Habu and Moto-mura, Ôsima, Idu-siti-tô.

80b. *Chasmichthys dolichognathus gulosus* (Guichenot)
Dorome

Saccostoma gulosum (Guichenot Ms.) Sauvage, 1882, p. 171; Japan.
Chasmias misakius Jordan et Snyder, 1901, p. 761, pl. 36; Tusima. (*gulosus* in a later paper.)

Marine goby, known from Japan and Korea.
Numerous specimens 30–135 mm; Nagasaki north to Kesen, Iwateken, on the Pacific coast and to Atumi, Yamagata-ken, on the coast of Japan Sea.

Genus 35. *Pipidonia* Smith

Pipidonia Smith, 1931, p. 39 (*P. quinquecincta* Smith).

81. *Pipidonia arenarius* (Snyder)
Isago-haze

Hetereleotris arenarius Snyder, 1908, p. 100; 1912, p. 513, pl. 67, fig. 3; Naha, Okinawa; Tanegasima.
?*Pipidonia quinquecincta* Smith, 1931, p. 39, fig. 19; Koh Pipidon, Siam.

Marine goby known from Okinawa and Tanegasima, Kagosima-ken.
No specimens at hand.

Genus 36. *Lophiogobius* Günther.

Lophiogobius Günther, 1873, p. 241 (*L. ocellicauda* Günther).
Ranulina Jordan et Starks, 1906, p. 522 (*R. fimbriidens* Jordan et Starks).

82. *Lophiogobius ocellicauda* Günther
Wani-haze

Lophiogobius ocellicauda Günther, 1873, p. 241; Shanghai.
Ranulina fimbriidens Jordan et Starks, 1906, p. 523, fig. 3; Port Arthur.

Marine goby. Eastern China north to Korea.
No specimens at hand.

Genus 37. *Parachaeturichthys* Bleeker

*Parachaeturichthys Bleeker, 1874, Syst. Nat. Gob., p. 325. (*Chaeturichthys polynema* Bleeker).

83. *Parachaeturichthys polynema* (Bleeker)
Hige-haze

Chaeturichthys polynema Bleeker, 1853, Japan, p. 43, fig. 4; Nagasaki.

Marine goby. Japan to Queensland and west to East Africa.
Twenty-eight specimens 65–100 mm; Hiro, Arita-gun, Wakayama-ken; Kasaoka, Okayama-ken; coast near Saizyô, Ehime-ken; Urado, Kôti-ken; Nagasaki; Formosa.

Genus 38. *Chaeturichthys* Richardson

Chaeturichthys Richardson, 1844, p. 54 (*C. stigmatias* Richardson).
*Amblychaeturichthys Bleeker, 1874, Syst. Nat. Gob., p. 324 (*Chaeturichthus hexanema* Bleeker).
?*Suruga* Jordan et Snyder, 1901, p. 96 (*S. fundicola* Jordan et Snyder).

Key to Japanese species of *Chaeturichthys*

a. Soft dorsal rays I-13 to 16.
    b. Scales about 35; caudal crossed by 4 or 5 dark bands .... *sciistius*
    bb. Scales usually more than 40; caudal uniformly dark or grey .... *hexanema*
aa. Soft dorsal rays about I-20; scales 50 or more................. *stigmatias*

84. *Chaeturichthys sciistius* Jordan et Snyder
Komoti-zyako

Chaeturichthys sciistius Jordan et Snyder, 1901, p. 107, fig. 22; Hakodate.

Marine goby known from Japan.
Numerous specimens 70–75 mm; Takenoura near Onagawa, Miyagi-ken; Kanazawa near Yokohama; Toyama Bay; Mie-ken; Wakayama; Hirosima; Beppu; Nagasaki; Kagosima.

85. *Chaeturichthys hexanema* Bleeker
Aka-haze

Chaeturichthys hexanema Bleeker, 1853, Japan, p. 43, fig. 5; Nagasaki.

?? *Suruga fundicola* Jordan et Snyder, 1901, p. 96, fig. 20; Suruga Bay; Matusima; Owari
    Bay; coasts of Prov. Sagami. Young with barbels rubbed off?

Marine and brackish water goby. Japan, Korea and China.

Seventy-three specimens 70–170 mm ; Nagasaki north to Sibata, Niigata-
ken, on the coast of Japan Sea ; Hososima, Miyazaki-ken, north to Watanoha,
Miyagi-ken, on the Pacific coast.

86. *Chaeturichthys stigmatias* Richardson
Yaki-in-haze

Chaeturichthys stigmatias Richardson, 1844, p. 55. pl. 35, figs. 1–3; southern Pacific Ocean.

Marine goby. South China ; Korea ; Tusima.

No specimens at hand.

Genus 39. *Sagamia* Jordan et Snyder

Sagamia Jordan et Snyder, 1901, p. 100 (*S. russula* Jordan et Snyder).
Ainosus Jordan et Snyder, 1901, p. 109 (*Gobius geneionema* Hilgendorf).

87. *Sagamia geneionema* (Hilgendorf)
Sabi-haze

Gobius geneionema Hilgendorf, 1879, p. 108; Tokyo Bay.
Ainosus geneionemus Jordan et Snyder, 1901, p. 109; Misaki; Tokyo.
Sagamia russula Jordan et Snyder, 1901, p. 100, fig. 21; Misaki, Kanagawa-ken; Wakanoura;
    Nagasaki. Based on examples with barbels rubbed off probably.
Chaeturichthys tanakae Schmidt, 1931, p. 135, fig. 23; Misaki, Kanagawa-ken. Young with
    6 barbels left and others rubbed off probably.

Marine goby known from Japan.

The barbels on ventral side of head are rubbed off easily.

Numerous specimens 60–95 mm ; Misaki, Kanagawa-ken ; Iwa near Oda-
wara ; Wakayama ; Uodu, Toyama-ken ; Iduhara, Tusima ; Beppu ; Nagasaki.

Genus 40. *Tridentiger* Gill

Tridentiger Gill, 1858, p. 16 (*Sicydium obscurum* Temminck et Schlegel).
Triaenophorus Gill, 1858, p. 17 (*Triaenophorus trigonocephalus* Gill).
Triaenophorichthys Gill, 1860, p. 195 (*Triaenophorus trigonocephalus* Gill).
Trifissus Jordan et Snyder, 1900, p. 373 (*Trifissus ioturus* Jordan et Snyder).

Key to Japanese species and forms of *Tridentiger*

  a. Scales about 40 . . . . *obscurus*
     b. Nape, posterior part of occiput and belly scaly . . . . *obscurus obscurus*
    bb. Nape, occiput and belly naked . . . . *obscurus nudicervicus*
 aa. Scales 50 to 60 . . . . *trigonocephalus*

88a.   *Tridentiger obscurus obscurus* (Temminck et Schlegel)

Titibu

Sicydium obscurum Temminck et Schlegel, 1845, p. 145, pl. 76, fig. 1; rivers in the bay of
  Nagasaki.
*Triaenophorichthys squamistrigatus Hildendorf, 1879, p. 111; Japan. Young.
Tridentiger coreanus Regan, 1908, p. 63, pl. 3, fig. 2; Chong-ju, Korea. Young.
Tridentiger kuroiwae Jordan et Tanaka, 1927, p. 276, pl. 23. figs. 1–3; Amami-Ôsima; Yaku-
  sima; Okinawa; Isiga. Form of Ryûkyû.
?Gobius (Ctenogobius) articeps Regan, 1905, p. 364; Inland Sea of Japan.

Fresh and brackish water goby. Hakodate to Ryûkyû; Korea.

Numerous specimens 30–135 mm; Hakodate south to Yaegaki-zima,
Ryûkyû. The specimens from Ryûkyû with the dark longitudinal band along
the side of body are identical with the description of *T. kuroiwae* Jordan
et Tanaka; this band of younger individuals of Japan is more obscure and
fades away with age.

Gobius articeps Regan is identical with this species in all the characters
but the teeth.

88b.   *Tridentiger obscurus nudicervicus* Tomiyama

Siro-titibu   Fig. 40.

Tridentiger nudicervicus Tomiyama, 1934, p. 328, fig. 2; Ariake Sound.

Brackish water goby, known from Ariake Sound.

Type and eight specimens 30–70 mm; Ariake Sound. This goby does not
grow so large as the preceding one.
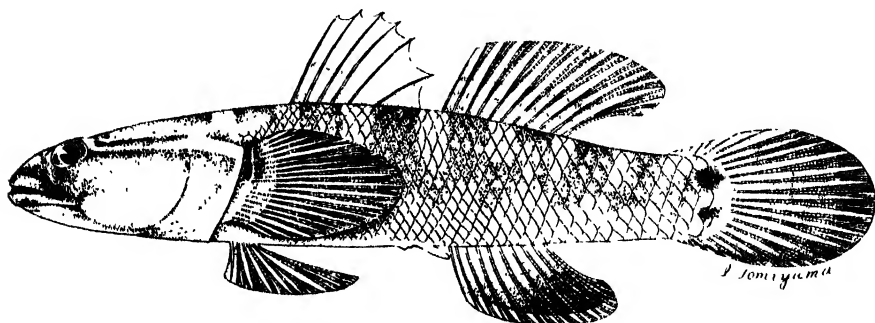
Fig. 40. *Tridentiger obscurus nudicervicus* Tomiyama. Type.

89.   *Tridentiger trigonocephalus* (Gill)

Sima-haze

*Triaenophorus trigonocephalus Gill, 1858, p. 17; China. Old example with longitudinal
  bands become indistinct.
Triaenophorichthys taeniatus Günther 1874, p. 156; China. Entire head and breast naked;
  two longitudinal bands on side of body.

Tridentiger bifasciatus Steindachner, 1881, Ichth. Beitr., X, p. 12, pl. 7, figs. 2 and 2a; Bay of Strietok near Vladivostok. Old example with two distinct longitudinal bands.

Trifissus ioturus Jordan et Snyder, 1900, p. 373, pl. 18; Tokyo Bay. (*bifasciatus* in a later paper.) Young with two longitudinal bands.

Tridentiger bucco Jordan et Snyder, 1901, p. 115, fig. 24; Misaki, Kanagawa-ken; Tokyo. Old example with longitudinal bands become indistinct.

Tridentiger genimaculatus Regan, 1905, p. 22, pl. 2, fig. 1; Inland Sea of Japan. Young with obscure longitudinal bands.

Tridentiger marmoratus Regan, 1905, p. 22, pl. 2, fig. 2; Inland Sea of Japan. Young.

Marine and brackish water goby. China north to Bay of Strietok near Vladivostok and Japan.

Numerous specimens 40–95 mm; Nagasaki north to Tobisima, Yamagata-ken, on the coast of Japan Sea and to Kesen, Iwate-ken, on the Pacific coast. In the specimens before me the two longitudinal bands are not always distinct, and the larger individuals with the bands become indistinct well agree with the descriptions of *T. trigonocephalus* by Herre, 1927, Gobies of Philippines, p. 285, and *T. bucco* by Jordan and Snyder.

Genus 41. *Triaenopogon* Bleeker

*Triaenopogon Bleeker, 1874, Syst. Nat. Gob., p. 312 (*Triaenophorichthys barbatus* Günther).

90. *Triaenopogon barbatus* (Günther)

Syôki-haze

Triaenophorichthys barbatus Günther, 1861, p. 90; probably from China.

Triaenopogon japonicus Rendahal, 1924, p. 27; Japan.

Marine and brackish water goby. China, Formosa north to Japan and Korea.

More than sixty specimens 40–120 mm; Tokyo Market; Wakayama south to Nagasaki; Tusima; Taihoku Market and Tainan Market, Formosa.

Genus 42. *Apocryptodon* Bleeker

*Apocryptodon Bleeker, 1874, Syst. Nat. Gob., p. 327 (*Apocryptes madurensis* Bleeker).

91. *Apocryptodon bleekeri* (Day)

Tabirakuti   Fig. 41.

**Apocryptes bleekeri* Day, 1876, Fishes of India, p. 300, pl. 64, fig. 3; 1889, p. 276; India to Malay Archipelago.

Apocryptodon malcolmi Smith, 1931, p. 47, fig. 22; mouth of Chantabum River, Siam.

Apocryptodon punctatus Tomiyama, 1934, p. 332, fig. 4; Ariake Sound.

?!*Apocryptodon montalbani* Herre, 1927, p. 277, pl. 22, fig. 3; Zarraga, Iloilo Prov., Panay. Young?

?!*Apocryptodon sealei* Herre, 1927, p. 278; Manila Market. Young?

?!*Apocryptodon taylori* Herre, 1927, p. 279, pl. 22, fig. 3; Odiogan, Tablas. Young?

Brackish water goby. India to Malay Arichipelago ; Ariake Sound, Japan ; Philippines ?

Type of *punctatus* and numerous specimens 20–80 mm ; Ariake Sound. *A. punctatus* and *malcolmi* may not be separable from *bleekeri* with a little higher depth and the scales on the side of head.
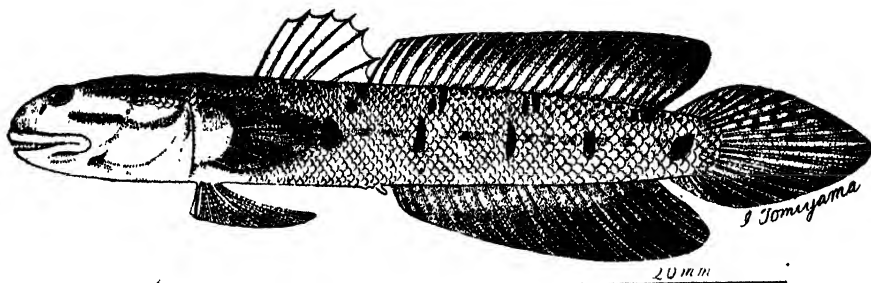
Fig. 41. *Apocryptodon bleekeri* (Day).

Genus 43. *Pseudapocryptes* Bleeker

*Pseudapocryptes Bleeker, 1874, Syst. Nat. Gob., p. 328 (*Eleotris lanceolatus* Bloch et Schneider).

92. *Pseudapocryptes lanceolatus* (Bloch et Schneider)

Hoko-haze

*Eleotris lanceolatus Bloch et Schneider, 1801, p. 67, pl. 15; Tranquebar.
Gobius changua Hamilton, 1822, p. 41, pl, 5, fig. 10; estuaries of Ganges. Figure very characteristic.

Marine and brackish water goby. India, East Indies, Polynesia and north to Japan.

A single specimen 150 mm, from Amami-Ôsima or the coast of Kagosima-ken, agrees well with the description and figure of *Apocryptes lanceolatus* by Day.

Genus 44. *Sicydium* Cuvier et Valenciennes

Sicydium Cuvier et Valenciennes, 1837, p. 167 (*Gobius plumieri* Bloch).
*Sicyopterus Gill, 1861, p. 101 (*Sicyopterus stimpsoni* Gill).
*Sicydiops Bleeker, 1874, Syst. Nat. Gob., p. 314 (*Sicydium xanthurus* Bleeker).
*Microsicydium Bleeker, 1874, Syst. Nat. Gob., p. 314 (*Sicydium gymnauchen* Bleeker).
*Sicya Jordan et Evermann, 1896, p. 456 (*Sicydium gymnogaster* Ogilvie Grant). Preoccupied; a genus of Lepidoptera.
Sicyosus Jordan et Evermann, 1898, p. 2867. New name for *Sicya*.
Oreogobius Boulenger, 1899, p. 125 (*O. rosenbergii* Boulenger).

93. *Sicydium japonica* Tanaka
Bôzu-haze

Sicydium japonica Tanaka, 1909, p. 22; Kôti-ken; Wakayama.
?Sicydium taeniurum Günther, 1875, p. 183, pl. 112, fig. C; Anteiteum; Namusi.
?*Sicydium halei Day, 1888, p. 794; 1889, p. 272; Ceylon.
?Sicyopterus exteraneus Herre, 1927, p. 311; Cabalian, Leyte; Cagoyan River, Misamis Prov.

Fresh water goby. Japan to Formosa.

Numerous specimens 45–165 mm; Yaita, Totigi-ken south to Kawanabe, Kagosima-ken; Amami-Ôsima; Taihoku, Formosa. The specimens before me have a pair of canines behind the symphysis of lower jaw and exhibit much variation in every character.

This species is most closely related to *S. externeus* Herre, and is suspected to be distributed to the tropics beyond Formosa.

Genus 45. *Periophthalmus* Bloch et Schneider

*Periophthalmus Bloch et Schneider, 1801, p. 63 (*Periophthalmus papilio* Bloch et Schneider).
*Euchoristopus Gill, 1864, p. 271 (*Periophthalmus koelreuteri* Bloch et Schneider).
*Periophthalmodon Bleeker, 1874, Syst. Nat. Gob., p. 326 (*Periophthalmus schlosseri* Cuvier et Valenciennes).

94. *Periophthalmus cantonensis* (Obseck)
Tobi-haze

*Apocryptes cantonensis Osbeck, 1757, p. 131 (pre-Linnaean); 1765, p. 171; Canton.
Periophthalmus cantonensis Jordan et Snyder, 1901, p. 49; Gyôtoku, Tokyo Bay.
*Gobius tannoao Osbeck, 1771, p. 201, Canton. Suggested to be identical with *cantonensis* by Richardson, 1846, p. 206.
*Gobius koelreuteri Pallas, 1770, p. 8, pl. 2, figs. 1-3.
Periophthalmus koelreuteri Günther, 1861, p. 97.
*Periophthalmus papilio Bloch et Schneider, 1801, p. 55; pl. 14; Tranquebar.— Cuvier et Valenciennes, 1837, p. 190. fig. 353; Senegal coast; Gorée.
*Periophthalmus kalolo Lesson, 1831, p. 146; Oualan.
Periophthalmus argentilineatus Cuv. et Val., 1837, p. 191; Waigiu; Oualan; Irrawaddy; Java.
Periophthalmus modestus Cantor, 1842, p. 484; Chusan.— Temminck et Schlegel, 1845, p. 147, pl. 76, fig. 2; Japan.
Periophthalmus chrysospilos Bleeker, 1852, Banka, p. 728; Karang hadji, Banka.
Periophthalmus kallopterus Bleeker, 1853, Amboina, p. 342; Amboina.
Periophthalimus dipus Bleeker, 1854, Banten, p. 320; Tjiringin, Java; Padang, Sumatra; Parantoka, Floris.
Periophthalmus barbarus (nec Linnaeus) Jordan et Seale, 1906, p. 293, fig. 1; Tutuila, Pago Pago; Apia.
Periophthalmus harmsi Eggert, 1928, p 398; 1935, p. 69, pl. 4, figs. 16 and 17; Poeloe Popale, Java.
Euchoristopus kaloro regius Whitley, 1931. p. 326; Queensland.
Periophthalmus pearsei Eggert, 1935, p. 57, pl. 3, fig. 10; Port Canning, India.
Periophthalmus variabilis Eggert, 1935, p. 63, pl. 3, fig. 13, pl. 4, figs. 14 and 15; text-figs 5–8; Java; Sumatra; Siam; Baboe I., Halmaheira.
Periophthalmus grasilis Eggert, 1935, p. 79, pl. 6, fig. 22; Java; Batavia; Sumatra.
Periophthalmus vulgaris Eggert, 1935, p. 80, pl. 6, figs. 23-26; pl. 7, figs. 27-30; Ceylon to New Guinea and Australia.
Periophthalmus minutus Eggert, 1935, p. 90, pl. 8, fig. 33, text-figs. 15 and 16; Sumatra.

Periophthalmus sobrinus Eggert, 1935, p. 95, pl. 9, figs. 37 and 38; Loe Arafal, Red Sea; Genova; Somali; Giumbo.

Marine and brackish water goby hopping along beach. Both coasts of Africa, Red Sea, India, East Indies, Australia, Polynesia and to Japan and Korea.

D. XI to XVII, I–10 to 12; A. I–10 to 12; V. I–5. Sq. l. 80 to 100; tr. a. about 25; tr. b. 30 to 35; tr. c. about 15, pred about 40.

Numerous specimens 15–105 mm; Tokyo south to Formosa; Korea. Ten specimens 40–140 mm; Caroline; Truk; Palau. The oblique bands on the body are more distinct in the specimens from Ryûkyû, Formosa and the islands south of Formosa; the largest specimen is uniformly dark except the paler ventral part of body.

This goby is a polymorphic species.

P. barbarus (Linnaeus), 1766, should apply to *P. schlosseri* (Pallas).

Genus 46. *Boleophthalmus* Cuvier et Valenciennes.

Boleophthalmus Cuvier et Valenciennes, 1837, p. 198 (*Gobius boddaerti* Pallas).

95. *Boleophthalmus pectinirostris* (Gmelin)
Mutugorô

*Apocryptes chinensis Osbeck, 1754, p. 29, fig. 23; Canton. Pre-Linnaean.
Boleophthalmus chinensis Jordan et Snyder, 1901, p. 47; Tokyo Bay; Nagasaki.
Gobius pectinirostris Gmelin, 1858, p. 264; China.
Boleophthalmus boddaertii (nec Cuvier et Valenciennes) Temminck et Schlegel, 1845, p. 148, pl. 76, fig. 3; Bay of Nagasaki. Figure very characteristic.
*Boleophthalmus inornatus Blyth, 1860, p. 168. Referred to *pectinirostris* by Day, 1869.

Marine and brackish water goby hopping along beach. Burma, Japan and Korea.

Numerous specimens 40–190 mm; Ariake Sound; Formosa.

Genus 47. *Scartelaos* Swainson

*Scartelaos Swainson, 1839, p. 279 (*Gobius viridis* Hamilton).
*Boleops Gill, 1864, p. 27, (*Boleophthalmus aucupatorius* Richardson).

96. *Scartelaos viridis* (Hamilton)
Tokage-haze

Gobius viridis Hamilton, 1822, p. 42, pl. 32, fig. 12; estuaries of Ganges.
Boleophthalmus histophorus Cuvier et Valenciennes, 1837, p. 210; Bombay; estuaries of Ganges. Scales absent.
Boleophthalmus sinicus et *chinensis* Cuv. et Val., 1837, p. 215. From Chinese drawings.
Boleophthalmus aucupatorius Richardson, 1845, p. 148, pl. 62, figs. 1–4; Woosung; Canton. Figures very characteristic.
Apocryptes macrophthalmus Castelnau, 1873, p. 87; Port Darwin.
*Gobiosoma guttulatum Macleay, 1878, p. 357; Port Darwin. Referred to *viridis* by Mc-Culloch and Ogilby.

Boleophthalmus chinensis (nec Osbeck) Franz, 1910, p. 66, pl. 9, fig. 71; Fukuura; Yokohama. Figure very characteristic.

?!* *Gobiosoma punctularum* De Vis, 1884, p. 449; probably from Banks Group. See the note given by McCulloch and Ogilby, 1919, p. 202.

Marine and brackish water goby hopping along beach. India, East Indies, Queensland to South China; Japan (Franz)?

Two specimens 105 and 120 mm; Hainan and some other locality of South China. No Japanese specimens at hand.

Genus 48. *Taenioides* Lacépède

Taenioides Lacépède, 1798, p. 532 (*T. hermanii* Lacépède).
Amblyopus Cuvier et Valenciennes, 1837, p. 157 (*T. hermanii* Lacépède).
*Psilosomus Swainson, 1839, p. 183 and 279 (*Gobioides rubicundus* Hamilton).
*Brachyamblyopus Bleeker, 1874, Sist. Nat. Gob., p. 329 (*Amblyopus brachysoma* Bleeker).
ᵛ*Odontamblyopus* Bleeker, 1874, Sist. Nat. Gob., p. 330 (*G. rubicundus* Hamilton).
*Leme De Vis, 1883, p. 286 (*L. mordax* De Vis).
Trypauchenopis Volz, 1903, p. 554 (*T. intermedius* Volz).
Caragobius Smith et Seale, 1906, p. 145 (*C. typhlops* Smith et Seale).
Trypauchenophrys Franz, 1910, p. 68 (*T. anotus* Franz).
Sericagobioides Herre, 1927, p. 335 (*S. lighti* Herre).
Nudagobioides Shaw, 1929, p. 1 (*N. nankaii* Shaw).

Key to Japanese species and form of *Taenioides*

a. Dorsal rays VI–30 to 34; small cycloid scales on posterior part of body....
anotus

aa. Dorsal rays VI–40 to 50
  b. A pair of large canines behind symphysis of lower jaw; rudimental scales on side of body; pectoral as long as or a little shorter than ventral sucker; upper pectoral rays free from membrane.............*rubicundus*
  bb. No canines behind symphysis of lower jaw; no scales; pectoral shorter than half length of ventral sucker; many dermal ridges on head ....
gracilis cirratus

97. *Taenioides anotus* (Franz)
Asagara-haze Fig. 42.

Trypauchenophrys anotus Franz, 1910, p. 68, pl. 9, fig. 77; Hukuura. Dorsal rays VI–26; anal rays about 30; no scales.

Brachyamblyopus olivaceus Herre, 1927, p. 329, pl. 25, fig. 3; La Libertad, Oriental Negros; strait between Iloilo and Negros.

?* *Amblyopus brachysoma* Bleeker, 1853, Sumatra, p. 510; Priaman. Body with small scattered scales, becoming larger posteriorly (Günther).
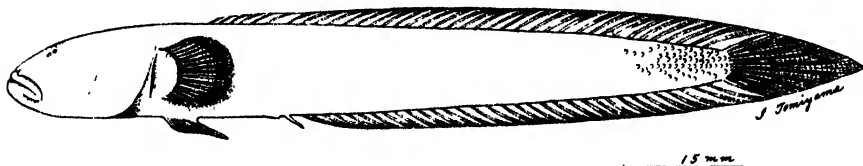
Fig. 42. *Taenioides anotus* (Franz).

Brackish water goby.   Japan to Philippines.

D. VI–30 to 34; A. I–29 or 30.   Sq. l. 5 to 17 on posterior part of body.

Five specimens 55–65 mm; Okinawa.   All these agree with the description of *B. olivaceus* Herre.

98.   *Taenioides rubicundus* (Hamilton)
Warasubo   Fig. 43.

Gobioides rubicundus Hamilton, 1822, p. 37, pl. 5, fig. 9; estuaries of Ganges.— Day, 1889,
   p. 301; seas of India and estuaries.
Amblyopus hermanianus (nec Cuvier et Valenciennes) Günther, 1861, p. 135; Ganges; China;
   East Indies.— Day, 1865, Malabar, p. 116; India; China.
Amblyopus lacepedei Temminck et Schlegel, 1845, p. 146, pl. 75, fig. 2; Ariake Sound;
   Ômura Sound.
Gobioides petersensii Steindachner, 1893, Ichth. Beitr., XVI, p. 235; Swatow.   Young;
   type 8.9 cm; head 6 in length, depth 8.5.
Taenioides abbotti Jordan et Starks, 1906, p. 524, fig. 4; Port Arthur.   Young; type 90 mm,
   head 5.8 in length; no scales.
Taenioides petschiliensis Rendahl, 1924, p. 31; Chihli, Pei-Tai-Ho, China.   Head smaller,
   8–8.6 in length; no scales.
Sericagobioides lighti Herre, 1927, p. 336, pl. 26, fig. 2; Amoy, China.
Nudagobioides nankaii Shaw, 1929, p. 2, 1 pl. and 2 text-figs.; Nankai, China.   Young; type
   105 mm; head 5.8 in length; no scales.

Marine and brackish water goby living in a hole of mud.   India, China north to Japan and Korea.

D. VI–40 to 47; A. 39 to 45; P. 28 to 30; V. I–5.   Head 7 to 7.5 in length; pectoral more or less than 1.5 in head; ventral as long as or a little longer than pectoral.   Scales rudimental, becoming larger posteriorly. Described from eleven specimens 220–330 mm.
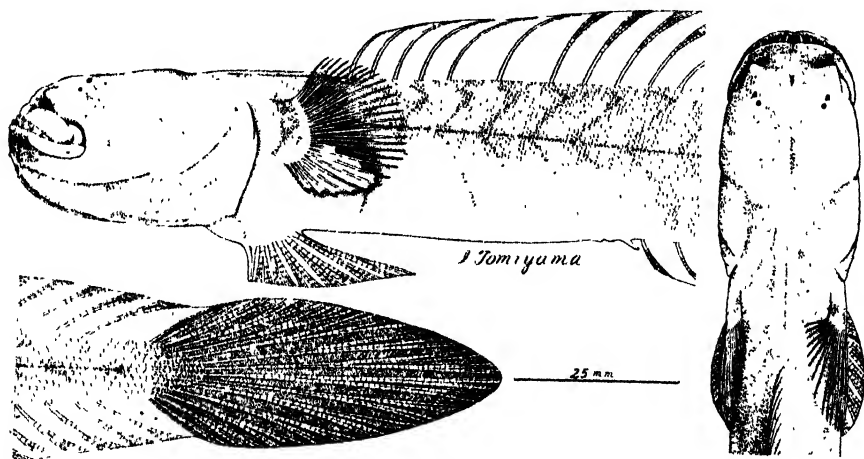
Fig. 43.   *Taenioides rubicundus* (Hamilton) Premaxillary protruded.

Fifty-five specimens 40–330 mm; Ariake Sound. All these agree well with the figure of *A. lacepedei* given by Temminck and Schlegel and the description of *S. lighti* by Herre. The rudimental scales in younger individuals are hardly visible. The presence of the scales has not been noted on Japanese specimens.

99.   *Taenioides gracilis cirratus* (Blyth)

Ti-warasubo   Fig. 44.

Amblyopus cirratus Blyth, 1860, p. 147; Calcutta.
Gobioides cirratus Day, 1889, p. 300; Hooghly.
Amblyopus brachygaster Günther, 1861, p. 134; East Indies.
Leme mordax De Vis, 1883, p. 286; Murray River, Australia.– McCulloch et Ogilby, 1919,
    p. 205, pl. 31, fig. 4; Ripple Creek; Herbert River; Cooktown.
Taenioides lacepedei (nec Temminck et Schlegel) Jordan et Snyder, 1901, p. 128, fig. 33;
    Wakanoura.
Taenioides snyderi Jordan et Hubbs, 1925, p. 310. Name for *lacepedei* Jordan et Snyder.

Marine and brackish water goby living in a hole of mud. India, East Indies, Queensland and north to Japan and Korea.

T. gracilis cirratus is distinguished from *T. g. gracilis* (Cuvier et Valenciennes) in having the dermal ridges on head and from *T. g. purpurascens* (De Vis) in having about 10 more rays of dorsal and anal fins.
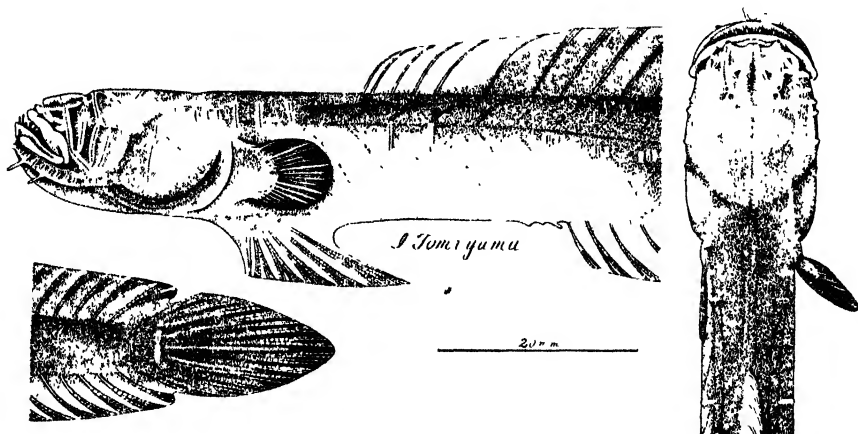
Fig. 44.   *Taenioides gracilis cirratus* (Blyth).

Genus 49.   *Trypauchen* Cuvier et Valenciennes

Trypauchen Cuvier et Valenciennes, 1837 (*Gobius vagina* Bloch et Schneider).
Trypauchenichthys Bleeker, 1860, Borneo, p. 63 (*T. typus* Bleeker).
Ctenotrypauchen Steindachner, 1867, Ichth. Not., IV, p. 530 (*C. chinensis* Steindachner).

Key to Japanese species and forms of *Trypauchen*

a. Head naked; teeth in outermost row in jaws not caninoid . . . . *vagina*
   b. Ventrals wholly united . . . . *vagina vagina*
   bb. Ventral sucker bilobate posteriorly. . . . . *vagina microcephalus*

100a.   *Trypauchen vagina vagina* (Bloch et Schneider)
Tenziku-akauwo

Gobius vagina Bloch et Schneider, 1801, p. 73; Tranquebar.
Gobioides ruber Hamilton, 1822, p. 38; estuary below Calcutta.— Hora, 1929, p. 185, pl. 18,
   fig. 2. Hamilton's figure reproduced.

Brackish water goby living in a hole of mud. India, East Indies and
north to Formosa.

Two specimens 135 and 185 mm; Tainan, Formosa. Günther and Franz
have recorded this goby from Kobe and Yokohama respectively, but I do not
know this goby does occur in Honsyû, Japan.

100b.   *Trypauchen vagina microcephalus* Bleeker
Akauwo

Trypauchen microcephalus Bleeker, 1860, Borneo, p. 62; Sungi-duri.
Trypauchen wakae Jordan et Snyder, 1901, p. 127, fig. 32; Inland Sea of Japan; Wakano-
   ura; Owari Bay; Kôbe.
Ctenotrypauchen barnardi Hora, 1926, p. 221, fig. 142; Natal coast, Africa. African form
   with larger head.

Brackish water goby living in a hole of mud. East Indies, Queensland
and north to Japan; South Africa.

D. VI rarely V–46 to 55; A 43 to 51; V. I–5. Sq. l. 50 to 70; tr.
a. 14 to 16; tr. b. 16 to 20. Head 6.5 to 7 in length, depth 9 to 10. Breast
and belly naked.

Fifty-nine specimens 30–130 mm; Wakayama; Tanabe, Wakayama-ken;
Kozima Sound, Okayama-ken; Murozumi, Yamaguti-ken; Ariake Sound; Naga-
saki; Kumamoto. The specimens before me agree with the figures of *T.*
wakae given by Jordan and Snyder and by Franz.

Trypauchen vagina chinensis (Steindachner) is a Chinese form with larger
head and the breast and belly covered with scales. And *T. v. typus* Bleeker
is a form of East Indies with the ventrals completely separated.

Conclusion

One hundred species of Gobiidae from the waters from Saghalien to
Formosa, Idu-siti-tô, and Korea were studied. I have divided the following
species into two or more forms: — *Eleotris pisonis* (Gmelin), *Eviota abax* (Jordan
et Snyder), *Ptereleotris microlepis* (Bleeker), *Luciogobius guttatus* Gill, *Astrabe*
lacticella Jordan et Snyder, *Gobius ornatus* Rüppell, *Amblygobius semicinctus*
(Bennett), *Pterogobius elapoides* (Günther), *Glossogobius giuris* (Hamilton),
Chaenogobius annularis (Gill), *Chaenogobius heptacanthus* (Hilgendorf), *Tri-*
dentiger obscurus (Temminck et Schlegel), *Taenioides gracilis* (Cuvier et Valen-
ciennes), and *Trypauchen vagina* (Bloch et Schneider). Temminck and Schlegel
described eleven species of Gobiidae from Nagasaki and its vicinity in 1845,

Bleeker enumerated twenty-four from Japan in 1879, Jordan and Snyder described fifty-seven from Japan in 1901, and Jordan, Tanaka and Snyder enumerated eighty-two from Hokkaidô to Kagosima-ken in 1913. And here I have given seventy-seven from Hokkaidô to Kagosima-ken, most of which are known from Idu-siti-tô, Korea, Ryûkyû and southward. Most of the species found in the waters of southern Japan, Ryûkyû and Formosa are the tropical species and widely distributed. The followings are the species and forms which are interesting in respect to the matter of variation : — *Eleotris pisonis fusca* (Bloch et Schneider), *Eleotris pisonis oxycephala* Temminck et Schlegel, *Mogurnda obscura* (Temminck et Schlegel), *Luciogobius guttatus guttatus* (Gill), *Gobiodon rivulatus* (Rüppell), *Gobius farcimen* (Jordan et Evermann), *Gobius fuscus* (Rüppell), *Gobius ornatus campbelli* (Jordan et Snyder), *Gobius gymnauchen* Bleeker, *Gobius similis* (Gill) Jordan et Snyder, *Gobius knighti* (Jordan et Evermann), *Awaous ocellaris* (Broussonnet), *Acanthogobius hasta* (Temminck et Schlegel), *Pterogobius elapoides elapoides* (Günther), *Glossogobius giuris* (Hamilton), *Chaenogobius annularis annularis* (Gill), *Chaenogobius annularis urotaenia* (Hilgendorf), *Tridentiger obscurus obscurus* (Temminck et Schlegel), *Tridentiger trigonocephalus* (Gill), and *Periophthalmus cantonensis* (Osbeck). All of these are polymorphic and the variation in some characters are so large that some individuals have the appearance different from that of the individuals identical with the original description or figure or of the individuals with the commonest appearance in a locality of the concerning species or form. In the species belonging to the genus *Tridentiger* the head is depressed and its general outline becomes pentagonal when viewed from above. The fins of *Tridentiger obscurus obscurus* (Temminck et Schlegel) and *Sycidium japonica* Tanaka become larger with age. In *Pterelotris microlepis evides* (Jordan et Hubbs) and *Pterogobius virgo* (Temminck et Schlegel) the markings on body vary with age.

Besides the species given in this paper good many tropical species are expected to be found from the southern part of Japan to Formosa and the Bonin Islands.

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6. Parasitic Copepods from Mollusks of Japan, I.

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(With Plates VII-XIII)

Of the seven species here described one is already known from New Guinea and the others are all new to science and belong to the following genera and families, one of which is proposed as new.

Myicolidae n. fam.

> *Pseudomyicola ostreae* n. g. n. sp.

Clausiidae

> *Panaietis haliotis* n. sp.
>
> *P. incamerata* Stebbing, 1900
>
> *Philoconcha amygdalae* n. g. n. sp.
>
> *P. paphiae* n. sp.
>
> *Paraphiloconcha meretricis* n. g. n. sp.

Lichomolgidae

> *Lichomolgus spondyli* n. sp.

MYICOLIDAE

1. *Pseudomyicola ostreae* n. sp.

Pl. VII, Figs. 1-11.

Two females were obtained on January 26, 1928, from the branchial cavity of *Ostrea (Ostrea) denselamellosa* Lischke cultured at the Hutami oyster-bed, Hyôgo Prefecture.

Body 2.1-2.43 mm long, uniformly greyish in alcohol. Head 0.45-0.51 × 0.525-0.625 mm, abruptly narrowed anteriorly, with setae on either side as in first thoracic segment, from which it is demarcated not very distinctly. Thorax 0.9-1.25 mm long; first to fourth segments almost uniformly broad, 0.67 mm in maximum breadth; fifth about half as long as and much narrower than fourth, but slightly broader than genital segment. Latter 0.225-0.26 × 0.28 mm, with two transverse rows of spines and scattered setae on ventral surface. Egg strings detached. Abdomen 3-segmented; first segment 0.12-0.13 × 0.2-0.21 mm, with about 10 setae on ventral side near posterior margin; second 0.1-0.11 × 0.175 mm; third 0.088-0.1 × 0.14-0.15 mm, with numerous small spines on ventral and outer sides near posterior end. Caudal rami narrow, 0.16-0.18 × 0.035-0.04 mm, each with two spines on outer margin, three at tip and numerous smaller ones on ventral side.

First antenna 6-segmented, about 0.3 mm long, enlarged at its proximal half; first segment with a slender, only slightly curved spine 51 μ long at anteromedial corner and 4 setae at distal anteroventral part; second incompletely segmented off from third, approximately triangular on ventral aspect, with about a dozen simple setae; third with 9 setae, one of which is on the dorsal side, fourth with 4, fifth with 3 setae, sixth with one subterminal and 6 terminal setae, one of which is much longer than the others. Second antenna 3-segmented; basal segment stout; middle about 0.225 mm long, arcuate, with one basal and three terminal setae, and covered with numerous minute spines; terminal claw pointed, comparatively short with a false joint near middle. Mandible terminating in two pectinate blades. First maxilla with four setae, of which the outermost is long and the two inner are difficult to see. Basal segment of second maxilla armed with numerous spines along posteroventral margin of its greater proximal portion; terminal blade fringed with 8 spines on inner side. Maxilliped knob-like, behind base of second maxilla.

First to fourth legs biramose; each ramus 3-segmented, fringed with spines on outer margin; each basipod indistinctly 2-segmented, with a seta and a row of 2–5 minute spines on outer side and a seta on inner side, fringed with spines along posteroventral margin between bases of both rami. Basipod of first leg with a stout pectinate spine and a group of smaller simple spines at its posteromedial corner.

The arrangement of spines and setae* on the first to fourth legs is as follows: First exopod 1~0, 2~1, 4~4; endopod 0~1, 0~1, 2~4; second exopod 1~0, 1~1, 4~5; endopod 0~1, 0~2, 3~3; third exopod 1~0, 1~1, 4~5; endopod 0~1, 0~2, 4~2; fourth exopod 1~0, 1~1, 4~5; endopod 0~1, 0~2, 4~1.

Fifth leg uniramose, 2-segmented; basal segment with one seta at dorsal distal end; terminal about twice as long as broad, with marginal setae at distal portion, a row of 4–10 setae on inner margin and a few oblique rows of spines on ventral surface.

REMARKS. This species bears a certain resemblance to *Myicola mitisiensis* Wright, 1885, but differs fundamentally in the possession of a very conspicuous spine at the base of the first antenna, in the structure of the second antenna and mouth parts, in the fifth leg being 2-segmented, etc. These differences are sufficient to justify the erection of a new genus, for which the name *Pseudomyicola* is proposed.

Pseudomyicola n. g.

GENERIC DIAGNOSIS. Myicolidae n. fam. Female body oblong. Head narrowed anteriorly, indistinctly separated from first thoracic segment. First to fourth thoracic segments almost uniformly broad; fifth segment considerably smaller. Genital segment quadrangular, with convex sides. Egg cases? Ab-

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* Some spines and setae are unable to distinguish from each other.

domen 3-segmented. Caudal rami narrow. First antenna 6-segmented, enlarged at proximal half, with a conspicuous basal spine. Second antenna 3-segmented, with a comparatively short terminal claw and a long arcuate penultimate segment. Mandible terminating in two pectinate blades. First maxilla with four setae. Second maxilla with numerous spines on basal segment and a terminal blade fringed with spines. Maxilliped knob-like, behind base of second maxilla. First to fourth legs biramose; each ramus 3-segmented, fringed with spines on outer margin; basipod indistinctly 2-segmented, fringed with spines between bases of exo- and endopods. First basipod with a stout pectinate spine at its posteromedial corner. Fifth leg 2-segmented. Male unknown.

Genotype *Pseudomyicola ostreae.*

<div align="center">Clausiidae</div>

<div align="center">2. *Panaietis haliotis* n. sp.</div>

<div align="center">Pl. VIII. Figs. 12-23; Pl. IX. Figs. 24-25.</div>

One male and three females with egg strings were found on May 1, 1929, in the mouth cavity of *Haliotis (Sulculus) gigantea* Gmelin from the Pacific coast.

FEMALE. Body elongate, tapering posteriorly, 7.4-7.6 mm long. Head broadened posteriorly, 0.92-0.98 mm long by 1.6-1.7 mm broad at posterior end, with nearly truncate frontal margin 0.62-0.7 mm broad. Five thoracic segments distinct, with rounded sides, gradually narrowed posteriorly, 2.8-3.0 mm long in combined length. Genital segment 0.5-0.6 mm long by 1.2-1.8 mm broad, with prominent sides. Egg strings 2.25-2.7 mm long by 0.4-0.5 mm broad; eggs large, rounded, in several longitudinal rows. Abdomen 4-segmented, nearly cylindrical, 2.1-2.2 mm long; first to third segments broader than long, but fourth longer than broad, 0.65-0.66 × 0.7-0.75 mm. Caudal rami 0.83-0.85 mm long, each tapering slightly toward distal end, which has one subterminal and four claw-like terminal spines.

First antenna 7-segmented, narrowed distally, 1.06-1.1 mm by 0.25 mm broad at base, with not very numerous small spiniform setae; terminal segment with four short setiform claws at tip and four setae on posterior margin. Second antenna stout, 3-segmented; first segment with a seta at distal end; second with a shorter pedunculated one on inner margin; third with a group of three small spines on inner margin and four terminal claws, one of which is very stout and the others are 2-segmented. Mandible terminating in a pointed blade with about a dozen sharp teeth, of which the two basal have each an accessory tooth, and a long slender spiniform ramus fringed with minute spines along its inner margin. First maxilla with an outer and an inner setae, the latter with a very small spine on either side of its base, and three spines close together near inner end. Second maxilla comparatively short, with four teeth on distal inner margin and two small mediodorsal spines near its base. Maxilliped with a rudimentary spine at its blunt-pointed end.

First to fourth legs biramose, each with 3-segmented rami. Proximal and middle segments of first to fourth endopods with a short stout spine at outer end of each pectinate distal margin ; corresponding segments of exopods with three similar spines and a comb close together on each outer margin. Each distal segment of first to fourth endopods with 8–9 spines, of which the outer ones form three groups of two each with a comb at each base and the inner ones are longer, pectinate and isolated ; corresponding segment of exopods with 11–12 spines, of which the outer ones form four groups of two each with a comb at each base and the inner ones are longer, pectinate and isolated. Fifth leg uniramose, digitiform, not reaching to posterior end of genital segment, with one seta and one spine at tip and two short subterminal spines, each of which is provided with a comb at the base.

MALE. Body 4.1 mm long, resembling female in general shape but differing from it notably in maxilliped and genital segment. Head 0.75 mm long by 1.2 mm broad. Thorax 1.75 mm long, gradually tapering posteriorly, 1.1 mm broad at first segment, 0.67 mm broad at the fifth. Genital segment nearly quadrangular, 0.4 × 0.625 mm, with a pair of ventral prominences bearing two setae on each posterior edge. Abdomen 4-segmented, 1.5 mm long ; first to third segments broader than long, fourth longer than broad. Caudal rami 0.67 × 0.15 mm. Proximal and distal segments of maxilliped of nearly same length ; terminal claw slender, 0.2 mm long, with a small spine on inner side of its base. Fifth leg reaching to posterior end of genital segment, with one seta and two spines at tip, and one subterminal spine on outer margin.

REMARKS. This species differs from *Panaietis incamerata* Stebbing, 1900, in the relative length of the abdomen and the armature of legs.

3. *Panaietis incamerata* Stebbing, 1900

Pl. IX, Figs. 26-36; Pl. X, Figs. 37-38.

Two males and some ten females, all fully mature, were found on December 28, 1935, in the mouth cavity of *Turbo (Batillus) cornutus* Solander from the Sea of Japan.

FEMALE. Body 6.8–8.8 mm long, with orange yellow digestive tract. Head approximately trapezoidal in dorsal view, 0.95–1.1 mm long by 1.25–1.5 mm broad, with an irregular median rib on dorsal side ; frontal margin truncate, 0.5–0.63 mm broad ; lateral margins widely divergent posteriorly, rounded at posterior ends, which cover up the anterolateral corners of the first thoracic segment ; posterior margin slightly convex posteriorly. First thoracic segment 0.37–0.5 × 1.13–1.17 mm, lateral margins convergent posteriorly ; each posterolateral corner rounded and produced backward, covering the anterolateral part of next segment. Second to fifth segments slightly narrowed posteriorly but of almost same length, with convex sides, each measuring 0.45–0.63 mm long by 0.6–1.0 mm broad. Genital segment 0.5–0.57 × 0.9–1.1 mm, with convex sides produced backward and outward. Egg strings 3.3–4.7 mm long, 0.31–

0.44 mm broad, slightly narrowed toward blunt-pointed posterior end. Eggs 0.125–0.15 mm in diameter, faceted, in several longitudinal rows. Abdomen nearly cylindrical, 2.6–3.6 mm long by 0.4 0.58 mm broad, 4-segmented. Caudal rami 0.71–1.05 mm long, roughly divided into two parts of nearly same length ; anterior part almost cylindrical, 0.16 0.23 mm broad, with a seta at distal outer end ; posterior part narrower than anterior, with a seta on inner margin near posterior end, which has a long spiniform and three shorter setae.

First antenna 7-segmented ; first and second segments with minute setae on ventral side ; third short, with two circular wrinkles and three setae on anterior margin ; fourth to sixth with setae near each distal end ; terminal with four setae on posterior margin, one longer spiniform and three shorter simple setae at tip. Second antenna 3-segmented ; first segment moderately stout, with a minute seta at distal inner end ; second with a similar one at middle of inner margin ; third with two outer setae, a very stout inner and three 2-segmented outer claws at tip, three small setae on inner margin, another on dorsal side and numerous minute spines on ventral surface. Terminal blade of mandible very long, tapering distally into a filament, armed along inner margin of its greater proximal portion with numerous teeth, of which the two proximal have each an accessory tooth. From the anterodorsal side of its base arises a long slender setiform spine which is directed forward and armed with minute teeth along its inner margin for its greater proximal portion. First maxilla with an outer and three inner setae, of which the middle is long and spiniform, while the other two are rather rudimentary. Terminal blade of second maxilla with five strong sharp teeth on distal inner margin and two small spines on mediodorsal side near its base. Maxilliped apparently 1-segmented, 0.25 mm long, blunt-pointed,

First to fourth legs biramose ; each ramus 3-segmented, showing the following arrangement of spines and setae : First exopod 1~0, 1~0, 4~3 ; endopod 0~0, 0~0, 2~4 ; second exopod 1~0, 1~0, 4~3 ; endopod 0~0, 0~0, 3~2 ; third exopod 1~0, 1~0, 4~3 ; endopod 0~0, 0~0, (3-4)~2 ; fourth exopod 1~0, 1~0, 4~3 ; endopod 0~0, 0~0, 1~(0-1). Each spine is blunt-pointed and has a double flange on either side. First to fourth legs may have a rudimentary spine on the outer margin of each of the first two segments of the endopods. Fifth leg uniramose, plump, 0.1–0.155 mm long by 0.045–0.08 mm broad, tipped with four setae, one of which is somewhat spiniform.

MALE. Body 4.9–5.1 mm long, with orange yellow digestive tract. Head trapezoidal, 0.7–0.85 × 1.0–1.25 mm, with an irregular median rib on dorsal side ; frontal margin about 0.43 mm broad ; posterior margin convex posteriorly. First thoracic segment 0.3–0.35 × 0.97–1.17 mm. Second to fourth segments with nearly parallel sides, each measuring 0.4–0.5 × 0.55–0.87 mm. Fifth segment slightly broader posteriorly, 0.25–0.3 × 0.51–0.63 mm. Genital segment 0.338–0.375 × 0.56–0.65 mm, with a pair of widely divergent ventral protuberances bearing each two setae. Abdomen 1.65 × 0.43 mm, 4-segmented, slightly narrowed posteriorly. Caudal rami 0.51–0.61 × 0.125–0.14 mm, armed as in female. First and second antennae, mandible and maxillae as in female.

Maxilliped 4-segmented; first and second segments stout; third short, with a minute spine; fourth forming a claw curved at nearly right angles. Legs as in female.

4. *Philoconcha amygdalae* n. g. n. sp.

Pl. X, Figs. 39–48; Pl. XI, Figs. 49–51.

Two mature males and one gravid female together with some immature ones were found on December 23, 1935, in *Venerupis (Amygdala) philippinarum* (Adams et Reeve) from Tiba Prefecture.

FEMALE. Body up to 6.6 mm long, elongate, with greenish digestive tract. Head approximately triangular, with strongly convex sides, sharply demarcated from first thoracic segment in immature specimens but fused more or less completely with the latter in adults and measuring about 1.2 mm broad at its somewhat prominent posterolateral corners; frontal margin prominent, with a rostrum projecting ventrad between bases of first antennae. Nauplius eye 0.2–0.27 mm from frontal margin. Cephalothorax and free thoracic segments arched dorsally and turned over ventrally; latter projecting outward beyond former, measuring 0.75×1.85 mm, 0.91×2.1 mm and 0.9×1.9 mm respectively. Fifth segment markedly narrower, 0.33 mm long by 0.7 mm broad, with a small rounded protuberance on either side in young, with uneven but nearly parallel sides in adults. Genital segment very short, 0.225 mm long by 0.6 mm broad, with somewhat convex sides. Abdomen almost cylindrical, 3- or 4-segmented, 1.25×0.5–0.6 mm. Caudal rami short cigar-shaped, 0.65–0.66×0.21–0.23 mm, each with a fine seta on outer margin behind its middle and five similar terminal ones, of which three are close together at the middle. Eggs small, rounded, 60–80 μ in diameter, multiseriate; length of egg strings unknown.

First antenna gradually tapering distally, about 0.3 mm long, 7-segmented, armed with not very numerous setae, tipped with a moderately long and a few shorter setae. Second antenna 5-segmented; first segment enlarged; second the longest, with a setiform spine on inner margin; third short, with two setae at distal end of inner margin; fourth also short, with a few very fine setae on distal margin; terminal claw sharp, about 0.1 mm long. Mandible terminating in a single, broad-based, bilaterally pectinate blade. First maxilla with two setae. Second maxilla stout at base; distal segment terminating in two setiform pectinate rami, with a spiniform seta on inner margin. Maxilliped swollen, with a digitiform process and two setae at tip.

First to fourth legs biramose; basipod 2-segmented, with a seta on inner margin of its proximal segment; each ramus 3-segmented except endopod of fourth leg, which consists of two, usually unarmed, nodular segments, terminal one being much smaller.

The arrangement of the spines, which are flanged on either side, and of the setae on the legs is as follows: First exopod 1~0, 1~1, 4~4; endopod

0~1, 0~1, 1~5; second exopod 1~0, 1~1, 4~5; endopod 0~1, 0~2, 3~(2-3), third exopod 1~0, 1~1, 4~4; endopod 0~1, 0~1, 3~2; fourth exopod 1~0, 1~ 1, 3~(2-4); endopod 0~(0-1), 0~0. Fifth leg uniramose, plump, slightly curved inward, tipped with a blunt spiniform inner process and a simple outer seta.

MALE. Body narrow, 2.7–2.8 mm long, greyish white, partly transparent. Head approximately triangular, with convex sides, 0.61 mm broad at posterior end, well fused with first thoracic segment; frontal margin prominent, with a rostrum projecting ventrad between bases of first antennae; nauplius eye about 0.13 mm from frontal margin. Cephalothorax and free segments projecting ventrad on either side but less prominently than in female. First fused seg-ment only slightly narrower than head, broader than second. Second to fourth segments diminishing in breadth posteriorly, measuring 0.2–0.21 × 0.51 mm, 0.18–0.19 × 0.41–0.42 mm and 0.225 × 0.338 mm respectively. Fifth segment strongly constricted off from fourth, fused with genital segment. Latter 0.34– 0.4 × 0.4–0.41 mm, with convex sides. Abdomen nearly cylindrical, 3-segmented, 0.65 mm long; first segment rounded, 0.2 mm long by 0.3 mm broad; second also rounded, but shorter; third 0.3–0.31 × 0.24–0.25 mm, with parallel sides. Caudal rami cigar-shaped, 0.45 × 0.12–0.13 mm, armed as in female. Maxilliped 1-segmented; penultimate segment very short; terminal claw falcate, 0.12– 0.138 mm long, with a slender basal accessory spine about 40 μ long.

The arrangement of spines and setae on the legs is as follows: First exopod 1~0, 1~1, 4~4; endopod 0~1, 0~1, 1~5; second exopod 1~0, 1~1, 4~5; endopod 0~1, 0~2, 3~3; third exopod 1~0, 1~1, (3-4)~(4-5); endopod 0~1, 0~1, 3~2; fourth exopod 1~0, 1~1, ?~(2-5). Fourth endopod has no spine or seta but may have sometimes a long and sometimes a rudimentary seta on its proximal segment.

5. *Philoconcha paphiae* n. sp.

Pl. XI. Figs. 52–62.

Four males and one female were found on December 26, 1935, in the pericardium of *Paphia euglypta* (Philippi) from the Inland Sea.

FEMALE. Body 7.5 mm long, with greenish digestive tract, which is much dilated anteriorly. Head 1.65 mm broad, with prominent frontal margin and knob-like ventral rostrum, fused completely with first thoracic segment, whose lateral margins converge posteriorly and pass on to dorsal side of second segment. Nauplius eye 0.33 mm from frontal margin. Second to fourth thoracic segments arched dorsally, with rounded sides projecting further out-ward than head, measuring 0.9 × 2.25 mm, 1.0 × 2.32 mm and 1.25 × 2.1 mm respectively. Fifth segment 0.3 mm long by 0.7 mm broad, with almost par-allel sides. Genital segment small, 0.25 × 0.65 mm, with slightly convex sides. Abdomen 1.3 mm long, 4–segmented; first segment 0.34 × 0.6 mm, second 0.35 × 0.5 mm, third 0.25 × 0.43 mm, fourth 0.375 × 0.45 mm. Caudal rami cigar-shaped, 1.1 × 0.25 mm, each with a seta on outer margin near middle and

five terminal ones, three of which are close together at the tip. Egg strings elongate, 3.5×0.4 mm ; eggs small, rounded, 75–90 μ in diameter.

First antenna 7-segmented, 0.4 mm long ; first segment rounded, relatively large, with three setae on ventral side, others gradually narrowed distally ; terminal tipped with a long and three shorter setae. Second antenna as in the foregoing species, with sharp terminal claw about 90 μ long. Mandible with a sharp bilaterally pectinate blade. First maxilla with two spiniform setae. Second maxilla tumid at base ; distal segment with two setiform pectinate rami at tip and a spiniform seta on ventromedial margin. Maxilliped tumid, tipped with a digitiform process and two small setae.

The arrangement of spines and setae on the legs is as follows : First exopod 1~0, 1~1, 4~4 ; endopod 0~1, 0~1, 1~5 ; second exopod 1~0, 1~1, 4~5 ; endopod 0~1, 0~2, 3~3 ; third exopod 1~1, 1~1, 4~4 ; endopod 0~1, 0~1, 3~2 ; fourth exopod 1~0, 1~1, 3~3 ; endopod 0~1, 0~0. Fifth leg uniramose, 1-segmented, slightly curved inward, with a short spine and a seta at tip.

MALE. Body 3.75–4.4 mm long, greyish white. Head completely fused with first thoracic segment. Cephalothorax 0.85–1.0 mm long by 0.8–1.0 mm broad, rounded ; frontal margin very prominent. Nauplius eye 0.16–0.2 mm from anterior margin. Second to fourth segments gradually narrowed posteriorly, measuring $0.25–0.34 \times 0.7–0.83$ mm, $0.18–0.28 \times 0.625–0.68$ mm and $0.27–0.3 \times 0.55–0.58$ mm respectively. Fifth segment completely fused with genital segment. Latter, including former, 0.55–0.63 mm long by 0.58–0.65 mm broad, with convex sides and a longitudinally elongate ventral swelling on either side of median line. Abdomen cylindrical, 0.8–1.05 mm long, 4-segmented ; first and second segments with convex sides, $0.23–0.33 \times 0.4–0.44$ mm and $0.18–0.26 \times 0.34–0.38$ mm respectively ; third and fourth fused, with almost parallel sides, former shorter than latter, measuring together $0.38–0.45 \times 0.31–0.34$ mm. Caudal rami cigar-shaped, $0.82–0.96 \times 0.15–0.25$ mm, armed as in female.

First and second antennae, mandible, first and second maxillae as in female. Maxilliped 4-segmented ; first and second segments moderately stout, third very short ; terminal claw falcate, 0.23 mm long, with a slender basal accessory spine 45 μ long.

The arrangement of spines and setae on the first to fourth legs is as follows : First exopod 1~0, 1~1, 4~4 ; endopod 0~1, 0~1, 1~5 ; second exopod 1~0, 1~1, 4~5 ; endopod 0~1, 0~(1-2), 3~3 ; third exopod 1~0, 1~1, 4~4 ; endopod 0~1, 0~1, 3~2 ; fourth exopod 1~0, 1~1, 3~(2-4), endopod 0~(0-1), (0-2)~0. Fifth leg as in female.

REMARKS. This species differs from the very closely related *P. amygdalae* in body size, in the armature of the appendages, etc.

Philoconcha n. g.

GENERIC DIAGNOSIS. Clausiidae Sars, 1918. Body elongate, with nauplius

eye. Head more or less completely fused with first thoracic segment, which is slightly narrower than head. Second to fourth thoracic segments free, broader than head in female but narrower in male, turned over ventrally on either side. Fifth segment definitely narrower than fourth, fused with genital segment in male. Genital segment with convex sides, shorter in female than in male, with a pair of ventral protuberances in male. Abdomen 3- or 4-segmented. Caudal rami cigar-shaped, with minute terminal setae. Egg strings long, easily detachable. Eggs small, rounded, multiseriate.

First antenna 7-segmented, gradually tapering distally, with not very numerous setae. Second antenna 5-segmented, prehensile. Mandible terminating in a pointed pectinate blade. First maxilla with two setae. Second maxilla tumid at base; distal segment terminating in two pointed pectinate rami, with an accessory seta on its inner margin. Maxilliped reduced, tipped with a digitiform process and two fine setae in female, but 4-segmented, with a long falcate terminal claw and an accessory spine in male. First to fourth legs biramose; basipod 2-segmented; each ramus 3-segmented, except fourth endopod, which consists of two, usually unarmed, nodular segments. Fifth leg uniramose, 1-segmented. Parasitic in marine pelecypods.

Genotype. *Philoconcha amygdalae.*

6. *Paraphiloconcha meretricis* n. g. n. sp.

Pl. XII, Figs. 63-75.

Numerous males and females were obtained on February 20, 1936, from the pericardium of *Meretrix lamarcki* Deshayes from the Sea of Japan.

FEMALE. Body 3.1–5.5 mm long, opaque white except digestive tract, which is dark brown owing to very fine pigment granules filling up the epithelium. Head completely fused with first thoracic segment. Cephalothorax approximately triangular, 0.75–1.2 mm long by 0.94–1.35 mm broad, with posterolateral corners rounded and turned over ventrally. Nauplius eye at level of bases of second antennae or a little further behind. Rostrum projecting ventrad. Frontal margin straight or only slightly convex, only 35 μ broad in the type 4.85 mm long; lateral margins slightly convex, thickened and turned over ventrally. Free thorax narrowed posteriorly, 1.0–1.8 mm long, 0.45–1.0 mm broad at its junction with cephalothorax. Each of second to fourth thoracic segments with a pair of blunt-pointed digitiform processes, which are directed posterolaterad and tend to increase in length posteriorly, measuring 0.37–0.85 mm, 0.4–0.9 mm and 0.42–0.95 mm respectively. Fifth segment with almost parallel sides, slightly narrower than genital segment. Latter with convex sides, 0.25–0.3 mm long by 0.36–0.48 mm broad. Egg strings slender, up to 9.5 mm long by 0.175 mm broad, somewhat broader at proximal end. Eggs rounded or polygonal, numerous, arranged in a few longitudinal rows. Abdomen not segmented, slightly narrowed posteriorly, 0.85–1.8 mm long, 0.25–0.37 mm broad at anterior end. Caudal rami slightly nar-

rowed posteriorly, 0.26–0.4 × 0.07–0.1 mm, each with a seta at about middle and another near distal end, of outer margin, and three terminal ones, of which the middle is much larger than the others.

·First antenna 7-segmented, gradually tapering distally, 0.35–0.42 mm long; second and third segments not distinctly jointed with each other on ventral side; first to sixth segments with numerous setae, most of which are on the ventral side; terminal segment with four on posterior margin and as many terminal setae, one of which is much larger than the others. Second antenna stout, 5-segmented; first segment with a seta at distal inner end; second with a seta on inner margin a little distal to its middle; third and fourth segments very short, former with three setae close together at distal end of inner margin; terminal segment forming a slightly curved claw 69–84 μ long, with a small spine at its base. Anterior lip strongly emarginate in median line. Mandible terminating in a sharp blade finely serrated on inner margin. First maxilla nodular, with two setae at tip and occasionally a setiform process on inner side. Second maxilla with a long slender plumose seta at base of its sharp, rather coarsely pectinate terminal blade, and a small seta on inner margin behind it. Maxilliped 3-segmented; middle segment with a small spiniform process on inner margin near distal end; terminal segment plump or nodular, unarmed.

First to fourth legs biramose; basipod 2-segmented, each segment elongated transversely, with a plumose seta at inner end of proximal segment; each ramus 3-segmented except endopod of fourth leg, which consists of two nodular segments. Terminal segment of first exopod with a conical process of exoskeleton at the outer side of the base of each spine.

The arrangement of the spines, which are flanged on either side, and setae on the first to fourth legs is as follows: First exopod 1~0, 1~1, 4~(3-4); endopod 0~1, 0~1, (1-2)~5; second exopod 1~0, 1~(1-2), 4~5; endopod 0~1, 0~(1-2), (2-3)~(2-3); third exopod 1~0, (0-2)~1, (3-4)~(4-5): endopod 0~1, 0~1, 3~2; fourth exopod 1~0, (0-1)~(1-2), (2-3)~(3-5); endopod 0~1, (0-1)~(0-1). Fifth leg uniramose, small, plump, tipped with a spiniform inner process and a simple outer seta.

MALE. Body tapering posteriorly, 2.4–2.75 mm long, colored as in female. Cephalothorax slightly more rounded than in female, 0.6–0.73 × 0.8–1.05 mm, with lateral margins and posterolateral corners turned over ventrally; latter may project backward as in female. Free thorax 0.55–0.65 mm long by 0.4–0.58 mm broad at anterior end. Second and third segments have each a pair of blunt-pointed, backwardly directed, lateral processes, of which the anterior is 0.32–0.35 mm long and the posterior 0.26–0.3 mm long. Fourth segment 0.13–0.16 × 0.3–0.33 mm, without lateral processes, though its posterolateral corners may project backward more or less prominently. Fifth segment fused with genital segment, markedly constricted off from fourth segment. Genital segment 0.37–0.4 × 0.35–0.41 mm, narrowed abruptly in front but truncate behind, with a pair of ventral swellings, each of which has a chitinous band on the inner side. Abdomen slightly tapering posteriorly, 0.7–0.86 mm long by 0.16–

0.24 mm broad, with three distinct constrictions indicating that it was 4-segmented in earlier developmental stages. Caudal rami 0.25–0.28 × 0.05–0.07 mm, armed as in female.

First antenna 7-segmented, armed as in female, 0.3–0.32 mm long. Second antenna 5-segmented; third segment with three setae on distal inner margin; terminal claw 66–78 μ long. Mandible, first and second maxillae as in female. Maxilliped 4-segmented; first two segments stout; second segment with a row of minute spines along proximal half of inner margin and a spine on mediodorsal side; third segment very short; terminal claw slender, falciform, 0.2–0.24 mm long, with a slender basal accessory spine 30–40 μ long.

The first to fifth legs are armed with spines and setae as follows: First exopod 1~0, 1~1, 4~(4–5); endopod 0~1, 0~1, 1~5; second exopod 1~0, 1~1, (3–4)~5; endopod 0~1, 0~(1-2), 3~3; third exopod 1~0, (0–2)~1, (3–4)~(4–5); endopod 0~1, 0~1, 3~(1-2); fourth exopod 1~0, (1–2)~1, (3–4)~(2–5); endopod 0~1, 0~(0–1). Fifth leg as in female.

REMARKS. This genus is distinguished from *Philoconcha* mihi by the possession of very conspicuous lateral processes on the free thorax, three pairs in the female and two pairs in the male, though very closely related to it in other structural details. In *Philoconcha* the free thorax of the female shows a tendency toward the lateral projections of the present species.

Paraphiloconcha n. g.

GENERIC DIAGNOSIS. Clausiidae Sars, 1918; closely related to *Philoconcha*. Body tapering posteriorly. Head completely fused with first thoracic segment, with nauplius eye. Thorax with a pair of long lateral processes on each of second to fourth segments in female, but with shorter processes on second and third segments in male, in which the fourth segment has no lateral processes, though it may project more or less prominently at its posterolateral corners. Fifth segment free in female but fused with genital segment in male. Genital segment with convex sides, shorter in female than in male, with a pair of ventral swellings in male. Egg strings long and slender; eggs numerous, in a few rows. Abdomen long, slightly tapering posteriorly, not segmented, though it may have three distinct constrictions. Caudal rami slightly narrowed posteriorly, tipped with three setae, one of which is much longer than the others. First antenna 7-segmented, gradually tapering distally, with not very numerous setae. Second antenna 5-segmented, prehensile; third and fourth segments very short. Mandible finely serrate. First maxilla with two setae. Second maxilla with a long slender plumose setiform spine at base of its pectinate terminal blade, and a small seta behind it. Maxilliped 3-segmented, with plump or nodular, unarmed, terminal segment in female; 4-segmented, with a long slender falcate terminal claw and an accessory spine in male. First to fourth legs biramose; basipod 2-segmented; each ramus 3-segmented, except fourth endopod, which has two poorly armed nodular segments. Fifth

leg uniramose, 1-segmented. Parasitic in marine pelecypods.
Genotype. *Paraphiloconcha meretricis.*

LICHOMOLGIDAE

7. *Lichomolgus spondyli* n. sp.

Pl. XIII. Figs. 76–84.

Two females without egg cases were found in August, 1926, in the mantle cavity of *Spondylus japonicus* Kuroda from the Pacific coast of Wakayama Prefecture.

Body cyclopoid, 1.68–1.75 mm long. Head convex on both sides, very prominent in front, well fused with first thoracic segment. Cephalothorax 0.62–0.63 × 0.75–0.8 mm. Rostrum blunt-pointed, turned backward against ventral surface of head. Free thorax 0.46–0.5 mm long, narrowed posteriorly; second to fourth segments somewhat produced backward at each posterolateral corner, averaging in breadth 0.65 mm, 0.5 mm and 0.33 mm respectively; fifth segment 0.1 × 0.18 mm, broadened at middle, with a rounded backward lobe at base of its leg. Genital segment 0.24–0.25 × 0.25–0.26 mm, broadest near anterior end and gradually tapering posteriorly. Abdomen cylindrical, 0.25–0.26 mm long, divided into three segments of nearly equal length and breadth. Caudal rami nearly cylindrical, 0.16–0.17 mm long by 0.05 mm broad at base, with a small seta on outer margin just distal to its middle and four terminal setae, of which the second, as numbered from the inner side, is very long.

First antenna slender, 0.4 mm long, 7-segmented, with not very numerous setae; second segment the longest, with a false segment between itself and the third; terminal segment tipped with three setae, one of which is much longer than the others. Second antenna 4-segmented; terminal claw about 0.1 mm long, penultimate segment with two moderately long setae close together at its distal end. Blade of mandible terminating in a filament, bilaterally pectinate for greater proximal portion. First maxilla with two short spines. Terminal segment of second maxilla with a seta on dorsal side, divided at its tip into two pectinate rami, one of which is produced forward into a long filament and the other shorter and spiniform. Maxilliped terminating in a small claw about 20 μ long.

First to fourth pairs of legs biramose; basipod 2-segmented, each proximal basipod with a plumose seta at inner end; each ramus 3-segmented except endopod of fourth leg, which consists of a short proximal and a longer distal segments.

The arrangement of spines and setae on the first to fourth legs is as follows: First exopod 1~0, 1~1, (3–4)~(4–5); endopod 1*~1, 1*~1, 1~5; second exopod 1~0, 1~1, (3–4)~(5–6); endopod 1*~1, 1*~2, 3~3; third exopod 1~0, 1~1, 3~6; endopod 1*~1, 1*~2, 3~2; fourth exopod 1~0,

* Rudimentary spine.

1~1, 2~6; endopod 1*~1, (1-2)~(0-1).   Each spine has a rudimentary spini-form process at the outer end of its base.   Fifth leg small, rounded. tipped with two spiniform setae, with a seta immediately in front of its base.

REMARKS.   This species differs from the most closely related *Lichomolgus robustus* Thompson et Scott, 1903, in the relative length of the body segments, the structure of the blade of the mandible, etc.

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EXPLANATION OF PLATES

Plate VII

Figs. 1-11. *Pseudomyicola ostreae* n. g. n. sp., female.

Fig. 1.   Entire animal, dorsal view.
Fig. 2.   Right caudal ramus, ventral view.
Fig. 3.   First antenna, ventral view.
Fig. 4.   Second antenna, ventral view.
Fig. 5.   Mouth parts, ventral view. Md mandible; Mx¹ first maxilla; Mx² second maxilla.
Fig. 6.   Second maxilla and maxilliped, ventral view.
Fig. 7-11. First to fifth legs, ventral view. I first leg, II second leg, III third leg, IV fourth leg, V fifth leg.

Plate VIII

Figs. 12-23. *Panaietis haliotis* n. sp.

Fig. 12.   Female, dorsal view.
Fig. 13.   Male, dorsal view.
Fig. 14.   Left caudal ramus of female, ventral view.
Fig. 15   Fifth leg and genital segment of male, ventral view.
Fig. 16.   First antenna of female, ventral view.
Fig. 17.   Second antenna of female, seen from inner side.
Fig. 18.   Mouth parts of female, ventral view. Md mandible; Mx¹ first maxilla; Mx² second maxilla.
Fig. 19.   Maxilliped of female, ventral view.
Fig. 20.   Maxilliped of male, ventral view.
Fig. 21.   First leg of female, ventral view.
Fig. 22.   Second leg of female, ventral view.
Fig. 23.   Third leg of female, ventral view.

Plate IX

Fig. 24-25. *Panaietis haliotis* n. sp. (continued)

Fig. 24. Fourth leg of female, ventral view.
Fig. 25. Fifth leg of female, ventral view.

Figs. 26–36. *Panaietis incamerata* Stebbing, 1900.

Fig. 26. Female, dorsal view.
Fig. 27. Male, dorsal view.
Fig. 28. Fifth leg and genital segment of male, ventral view.
Fig. 29. First antenna of female, ventral view.
Fig. 30. Second antenna of female, ventral view.
Fig. 31. Mouth parts of female, ventral view. Md mandible; Mx^1 first maxilla; Mx^2 second maxilla.
Fig. 32. Maxilliped of female, ventral view.
Fig. 33. Maxilliped of male, ventral view.
Fig. 34. First leg of female, ventral view.
Fig. 35. Second leg of female, ventral view.
Fig. 36. Third leg of female, ventral view.

Plate X

Figs. 37–38. *Panaietis incamerata* Stebbing, 1900. (continued)

Fig. 37. Fourth leg of female, ventral view.
Fig. 38. Fifth leg of female, ventral view

Figs. 39–48. *Philoconcha amygdalae* n. g. n. sp.

Fig. 39. Female, dorsal view.
Fig. 40. Male, dorsal view.
Fig. 41. First antenna of female, ventral view.
Fig. 42. Second antenna of female, ventral view.
Fig. 43. Mouth parts of female, ventral view. Md mandible; Mx^1 first maxilla; Mx^2 second maxilla.
Fig. 44. Maxilliped of female, ventral view.
Fig. 45. Maxilliped of male, ventral view.
Fig. 46–48. First, second and third legs of male, ventral view.

Plate XI

Figs. 49–51. *Philoconcha amygdalae* n. g. n. sp. (continued)

Fig. 49. Fourth leg of male, ventral view.
Fig. 50. Endopod of fourth leg of female, ventral view.
Fig. 51. Fifth leg of male, ventral view.

Figs. 52–62. *Philoconcha paphiae* n. sp.

Fig. 52. Female, dorsal view.
Fig. 53. Male, dorsal view.
Fig. 54. First antenna of female, ventral view.
Fig. 55. Second antenna of female, ventral view.

Fig. 56. Mouth parts of female, ventral view. Md mandible; Mx¹ first maxilla; Mx² second maxilla.

Fig. 57. Maxilliped of female, ventral view.
Fig. 58. Maxilliped of male, ventral view.
Fig. 59. Third leg of male, ventral view.
Fig. 60. Fourth leg of male, ventral view.
Fig. 61. Endopod of fourth leg of male, ventral view.
Fig. 62. Fifth leg of male, ventral view.

Plate XII

Figs. 63–75. *Paraphiloconcha meretricis* n. g. n. sp.

Fig. 63. Female, dorsal view.
Fig. 64. Male, dorsal view.
Fig. 65. Fifth and genital segments of male, ventral view.
Fig. 66. First antenna of female, ventral view.
Fig. 67. Second antenna of female, ventral view.
Fig. 68. Mouth parts of female, ventral view. Md mandible; Mx¹ first maxilla; Mx² second maxilla.
Fig. 69. Maxilliped of female, ventral view.
Fig. 70. Maxilliped of male, ventral view.
Fig. 71. First leg of male, ventral view.
Fig. 72. Second leg of female, ventral view.
Fig. 73. Third leg of female, ventral view.
Fig. 74. Fourth leg of female, ventral view.
Fig. 75. Fifth leg of female, ventral view.

Plate XIII

Figs. 76–84. *Lichomolgus spondyli* n. sp., female.

Fig. 76. Entire animal, dorsal view.
Fig. 77. First antenna, ventral view.
Fig. 78. Second antenna, ventral view.
Fig. 79. Mouth parts, ventral view. Md mandible; Mx¹ first maxilla; Mx² second maxilla; Mp maxilliped.
Fig. 80. First leg, ventral view.
Fig. 81. Second leg, ventral view.
Fig. 82. Third leg, ventral view.
Fig. 83. Fourth leg, ventral view.
Fig. 84. Fifth leg, dorsal view.

37 *IV*

0.2 mm

38 *V*

0.1 mm

42

0.05 mm

Md

Mx'

Mx²

39

1 mm

40

1 m.m

45

0.05 mm

41

0.1 mm.

0.05 mm

48 *III*

0.05 mm

44

0.05 mm

46 *I*

0.05 mm

47 *II*

0.05 mm

43

0.1 mm

49 *IV*

51 *V*

52

53

c 05mm

c 05mm

50 *IV*

55

c 0k mm

57

l mm

1 mm

1 mm

1 mm

58

54

60 *IV*

O lmm

0 lmm

0 lmm

59 *III*

56

Md

61 *IV*

62 *V*

Mx¹

Mx²

0 05mm

06mm

0 lmm

0.lmm

63

64

65

72 II

66

75 V

68

Md.

Mx¹

69

74 IV

67

70

71 I

73 III
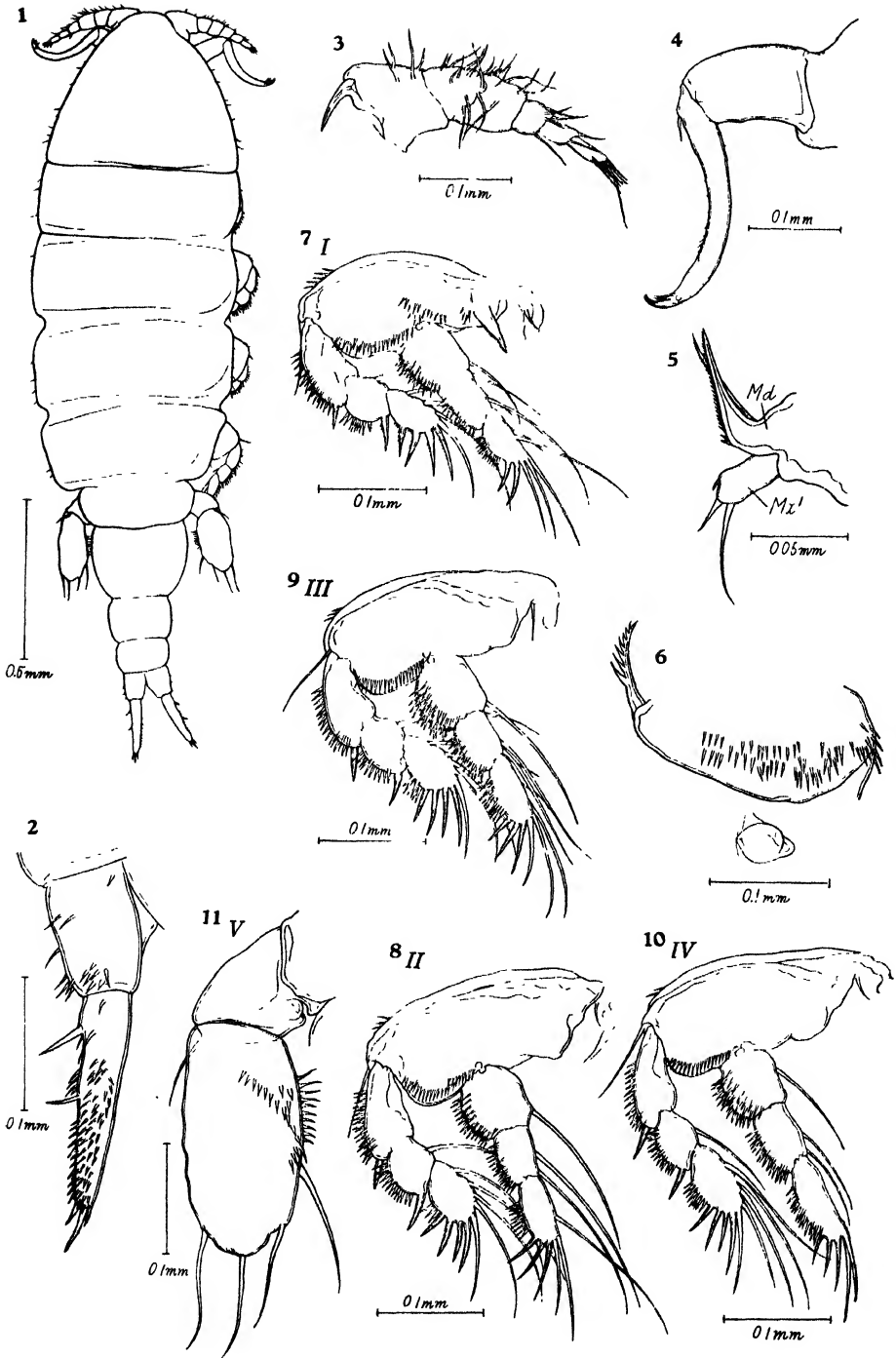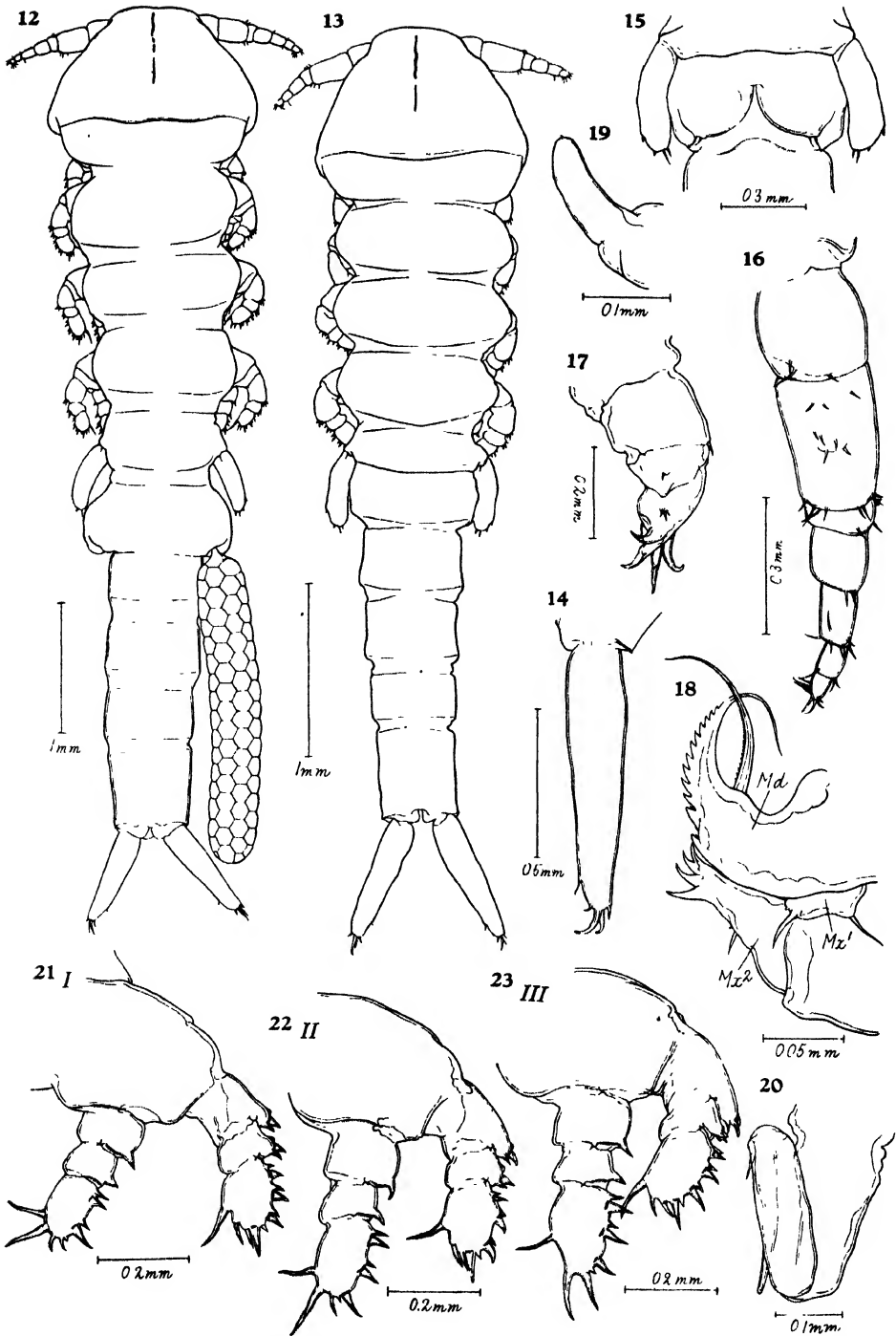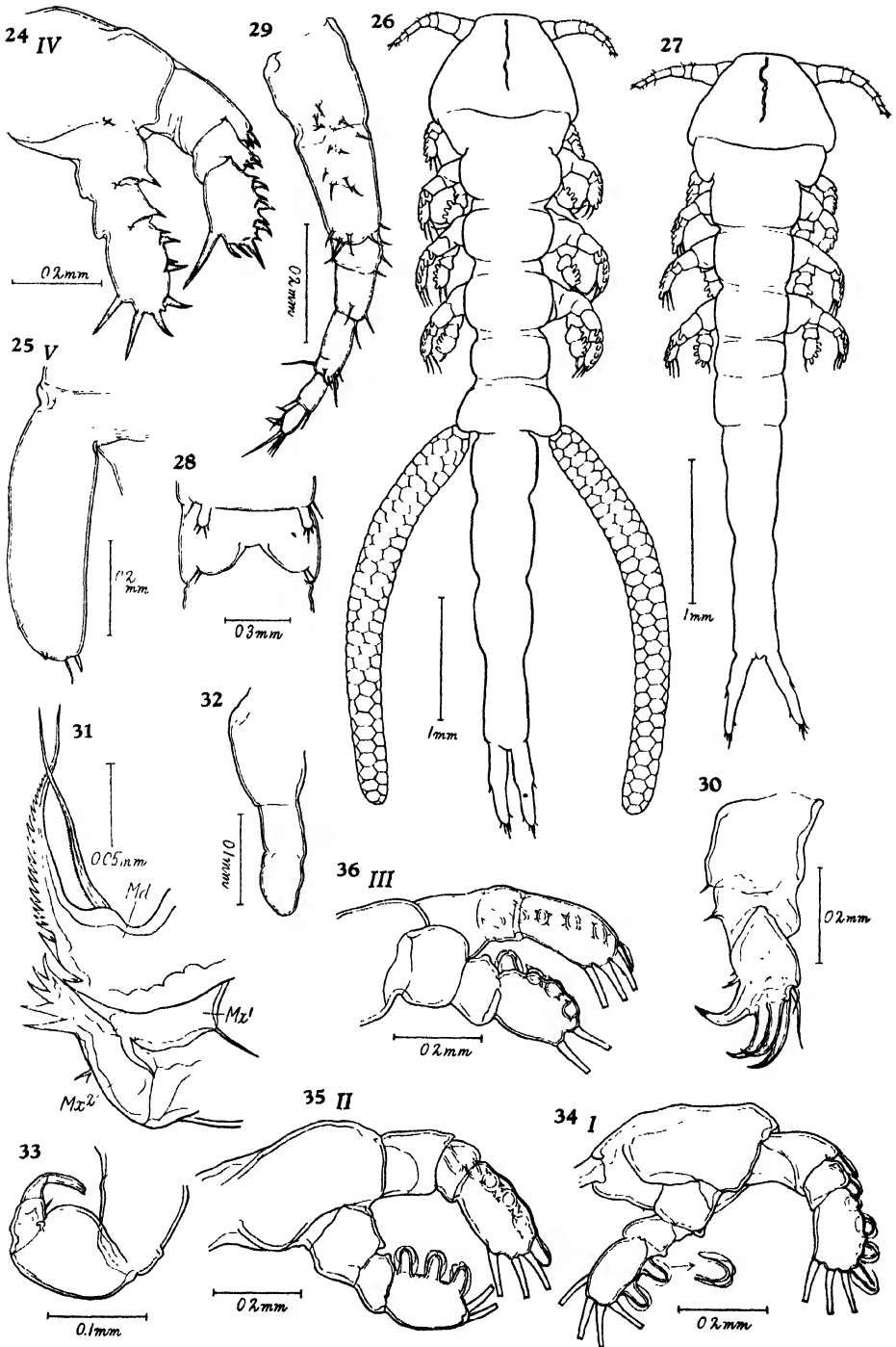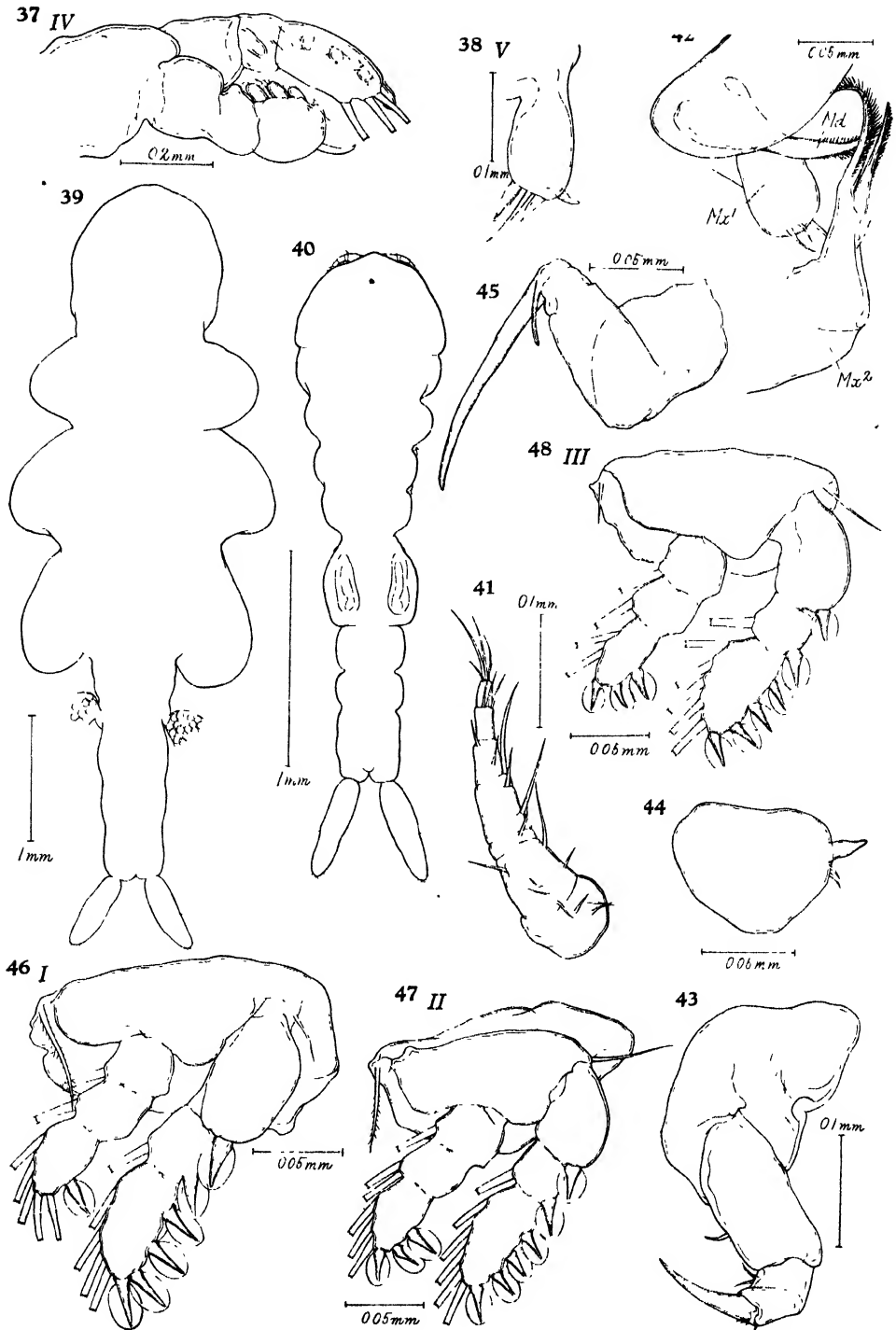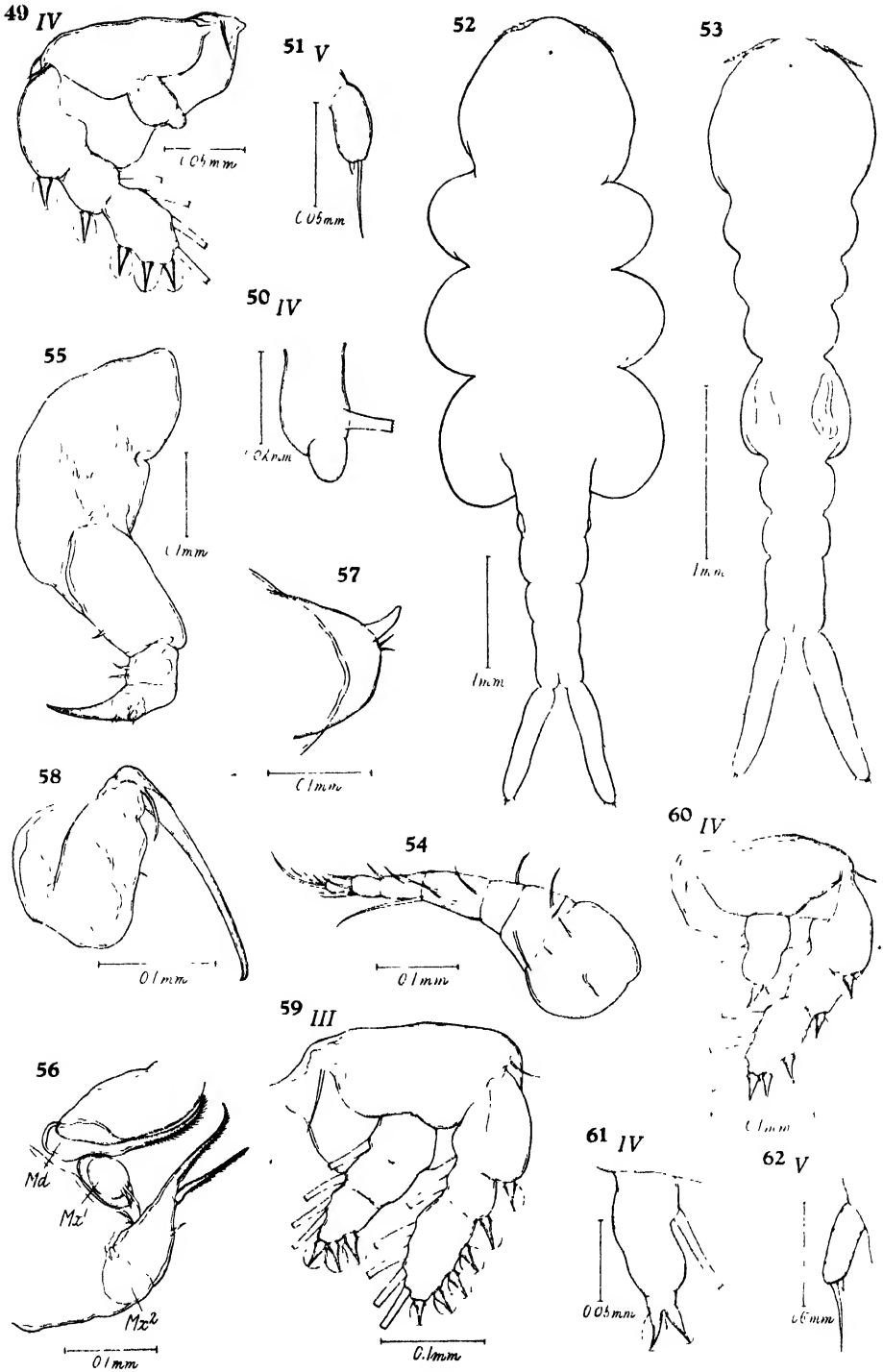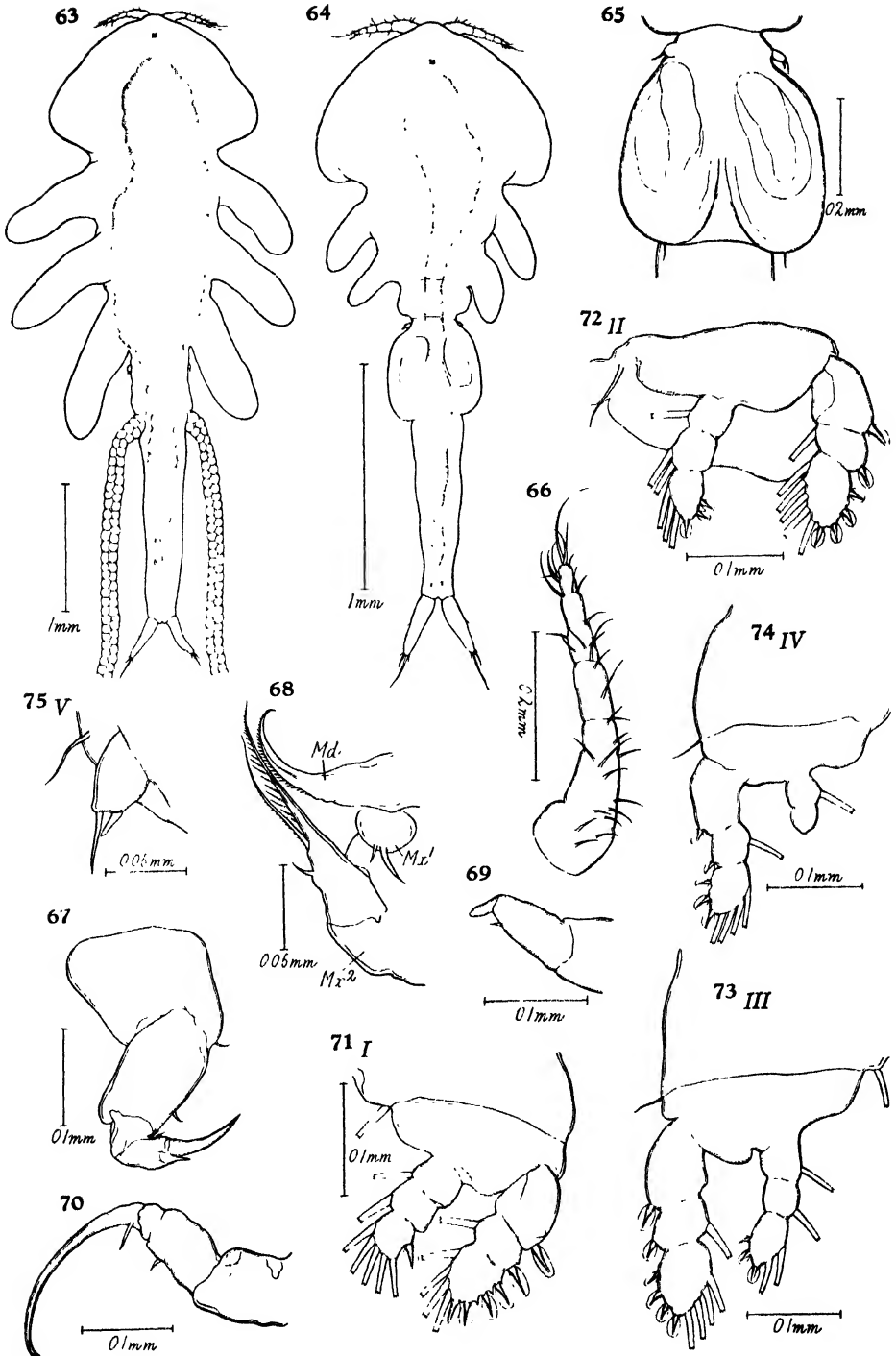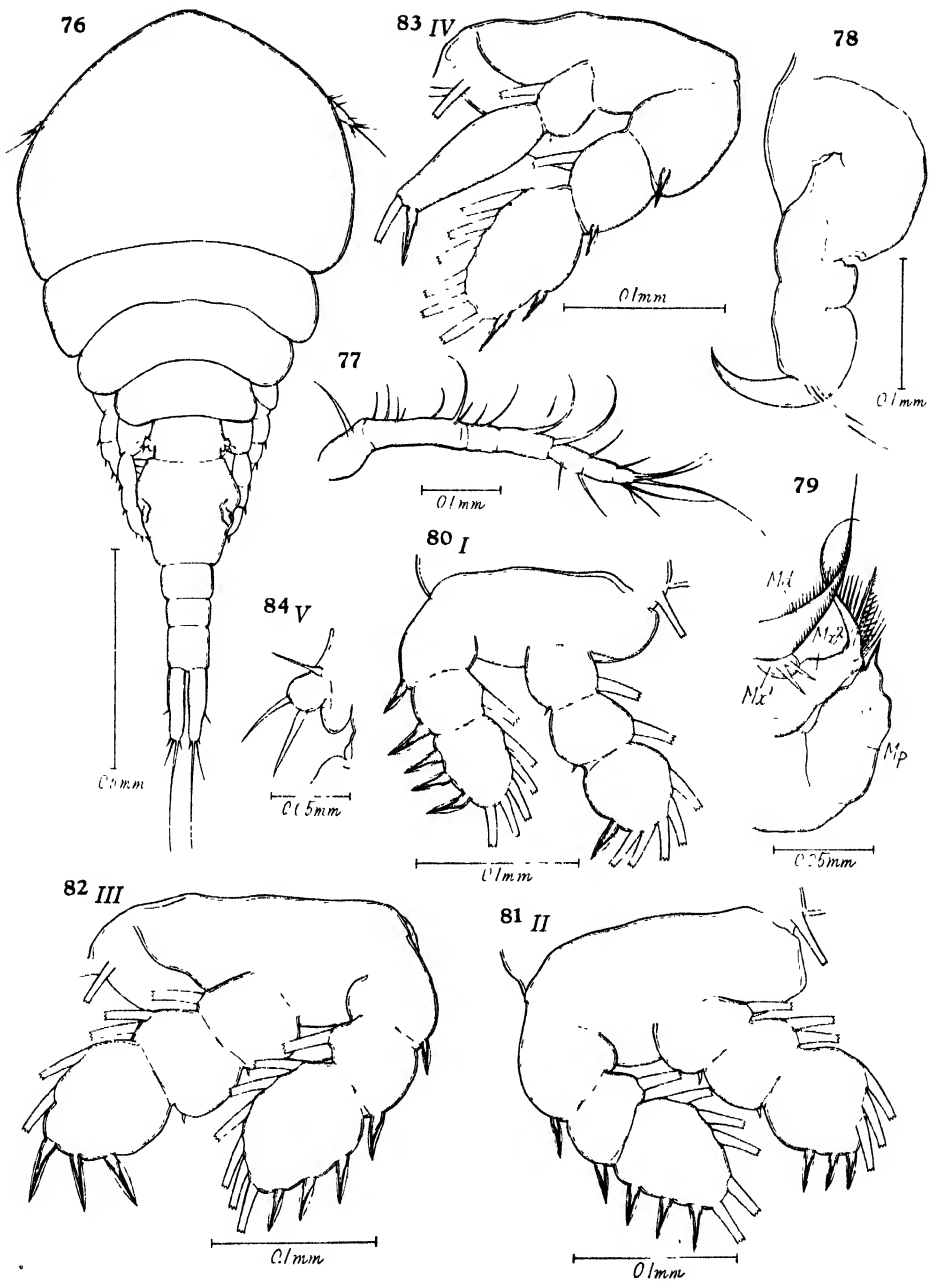
7. Some Rare and New Species of Decapod Crustaceans Found in the Vicinity of the Misaki Marine Biological Station

By Yu Yokoya

Fisheries Institute, Faculty of Agriculture, Tokyo Imperial University

(With 10 Text-figs.)

The species which will be described in this paper were mostly collected by Messrs. Saburo Murayama and Yasuo Ohsima, who kindly allotted all Decapod specimens in their collection to my examination. I wish to express my hearty thanks to the gentlemen.

Tribe EUCIPHIDEA

Family ALPHEIDAE Bate

Genus *Athanas* Fabr.

Athanas ohsimai n. sp.

Fig. 1.

The present species was collected by Mr. Y. Ohsima in tidal pools at Aburatubo. According to him it is common in that region and easily kept alive in a small aquarium.

All the specimens are small in size, in the largest male it is 11,8 mm long and in the smallest female 9,5 mm long, measuring from the tip of the rostrum to the end of the telson. The body is rather stout and its surface smooth. The carapace is scarcely $\frac{1}{2}$ as long as the abdomen. The rostrum, which is triangular in dorsal view, is terminally acutely pointed and exceeds the middle of the second peduncular joint of the first antenna. Without supracorneal tooth. In the first antenna, the stylocerite scarcely reaches the distal end of the second peduncular joint; the two flagella are nearly equal in length, the outer one branched at the fourth or fifth proximal article. The second antenna bears the scaphocerite a little exceeding the distal end of the second peduncular joint of the first antenna; the peduncle attains the level of the distal end of the rostrum. The mandible is distinctly divided into two processes and bears a broad two-jointed palp. The outer process corresponding the endopodite of the first maxilla is terminally two lobed and on each of the lobes there is a seta. The median lobe of the second maxilla corresponding endopodite is very small and devoid of setae; the outer foliaceous plate bears marginal setae of almost equal length. The first maxilliped has the long exopodite which is armed with four long setae at the distal end, and on the outer margin of the basal expansion there are some setae; the next inner
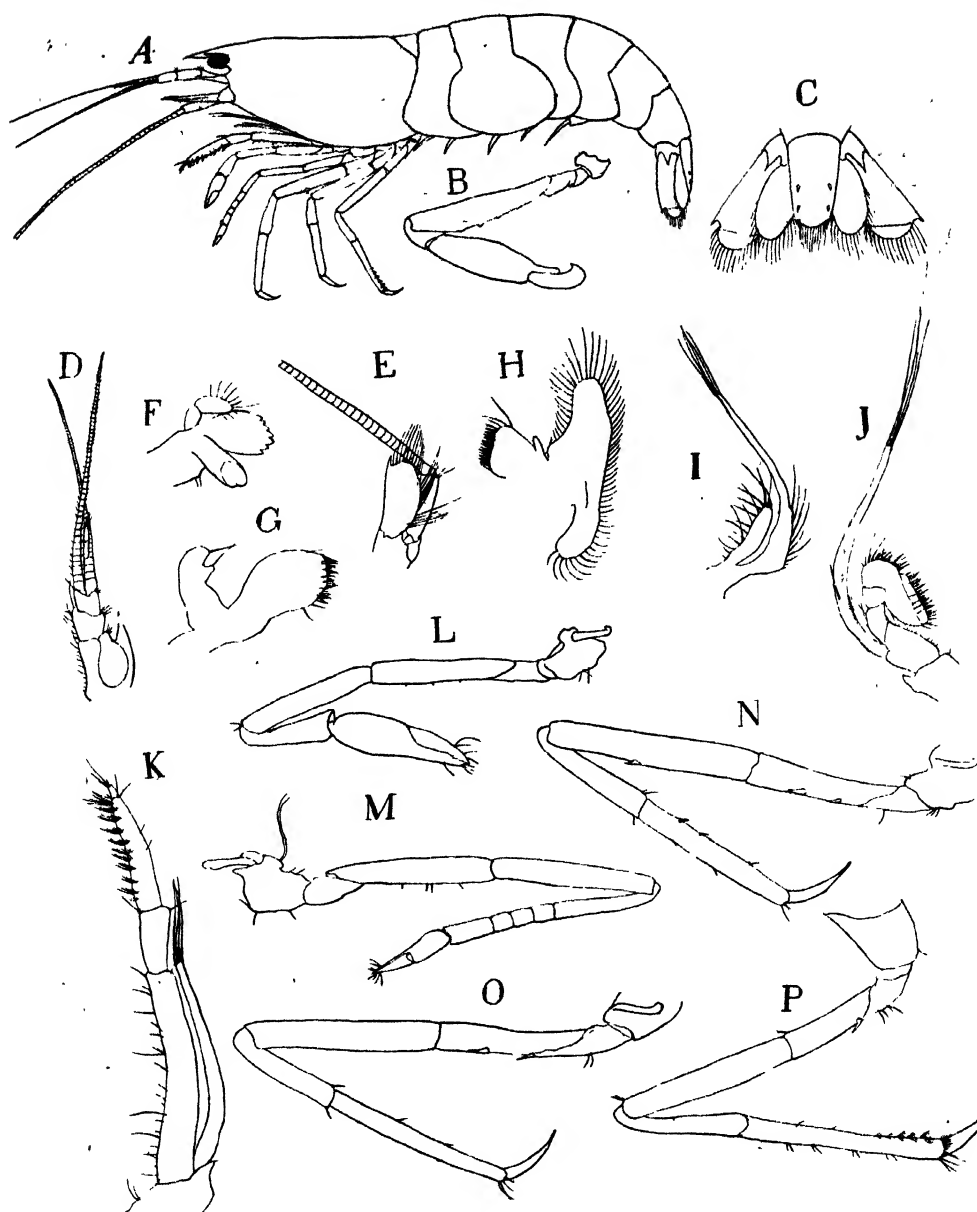
Fig. 1. *Athanas ohsimai* n. sp.
  A. Entire animal of a female, view from left side. (×8)
  B. Left cheliped of a male. (×6⅔)
  C. Rhipidula, dorsal aspect. (×13⅓)
  D. First antenna, dorsal aspect. (×13⅓)
  E. Second antenna, dorsal aspect. (×13⅓)
  F. Mandible. (ca. ×133)
  G. First maxilla. (ca. ×53)
  H. Second maxilla. (ca. ×21)
  I. First maxilliped. (ca. ×17)

  J. Second Maxilliped. (ca. ×17)
  K. Third Maxilliped. (ca. ×17)
  L. First leg of female. (ca. ×17)
  M. Second leg. (ca. ×17)
  N. Third leg. (ca. ×17)
  O. Fourth leg. (ca. ×17)
  P. Fifth leg. (ca. ×17)

lobe is comparatively well developed and emarginated by some numbers of setae. The exopodite of the second maxilliped bears four or five setae on the distal end and one more seta near proximal $1/3$. In the third maxilliped, the exopodite reaches the distal end of the proximal joint of the endopodite. The terminal joint of this endopodite is very small and appears to be an appendix of the penultimate joint.

The first ambulatory leg is quite different in sexes. In the male it is long and stout; the merus is long and provided with three or four small tubercular processes on the posterior margin, the carpus is short about $1/3$ as long as the palm of the chela, which is long and stout; the finger is half-moon shaped and the immovable finger is much shorter than the movable one. In the female, however, it is more slender; the merus is nearly as long as the ischium; the carpus, which is a little shorter than $2/3$ the length of the merus, is longer than the palm of the chela; the finger is nearly as long as the palm. In the second leg, the merus is as long as the ischium; the carpus is subdivided into five articles, in which proximal one is as long as the remaining four articles altogether; in these four articles, the proximal three are subequal in length and each is about $1/2$ as long as the terminal one. The palm of the chela is as long as the terminal carpal article, and the finger is a little shorter than the palm. The posterior three pairs of the legs are similar in general appearance; but in the third leg, the ischium is provided with two spinules, merus with one and propodus with two or three on their posterior margins respectively. In the fourth leg, two spinules are on the ischium, but no one on the other segments; and the posterior spinule of the ischium is just in front of the basis. In the fifth leg, the ischium is armed with a single spinule just in front of the basis; the propodus bears some numbers of bundles of setae on its distal half. All the legs but the last one are each provided with a rudimentary epipodite.

The abdomen, the surface of which is smooth, is almost $2^1/_2$ times as long as the carapace excluding the rostrum, and the epimeron of each somite is posteriorly rounded. The telson, which is a little shorter than the sixth abdominal somite, is about $1/2$ as broad as long at the base, and the terminal margin is obtusely rounded. On the dorsal aspect there are two pairs of spinules, and two more are on each of the outer corners of the distal margin.

The species is nearly allied to *Athanas haswelli*, *A. orientalis* and *A. minikoensis* (de Man, 1911). But in the present species, the carpus of the first leg of the male is much shorter than those of these species; even in the female the carpus is nearly $2/_5$ as long as the chela and it is somewhat inflated at the distal end.

Genus *Betaeus* Dana

Betaeus murayamai n. sp.

Fig. 2.

One probably male specimen was collected by Mr. S. Murayama in December 1933.

The specimen is rather small in size, 15,5 mm long. Body moderately laterally compressed, surface almost smooth and naked. The anterior margin of the orbital hood is almost truncated; between the orbital hoods in the place of a rostrum, the carapace is notched as in the case of *B. granulimanus* Yokoya (1927, p. 173, Pl. VII, Figs. 17–22.), and the notch is continuous to the median groove between the orbital hoods. Pterygostomian angle rounded.

The basal peduncular joint of the first antenna produces at the antero-lateral corner to a spine, which exceeds the middle of the second joint; the basal appendix or stylocerite reaches the end of the second joint; the second and the third joints are nearly equal in length; outer flagellum longer than half of inner, proximal half of the former is thick, but not bifurcated. The basal joint of the second antenna is provided with a small spine on the inferior side; scaphocerite a little longer than the peduncle of the first antenna and nearly as long as that of the second one. Third maxilliped exceeds a little
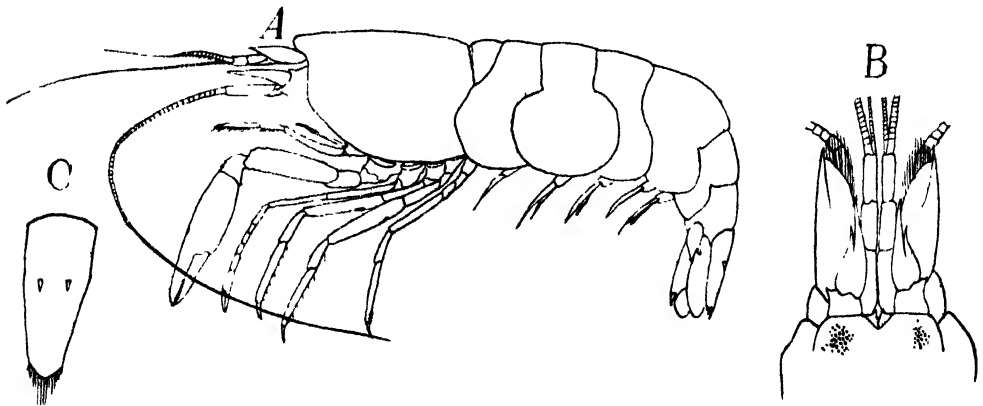
Fig. 2. *Betaeus murayamai* n. sp.
    A. Entire animal, view from left side. (×4)
    B. Frontal and antennal region of the carapace, dorsal aspect. (×8)
    C. Telson, dorsal aspect. (×8)

the end of the peduncle of the second antenna; the proximal joint of the endognath is not so granulated as that of *B. granulimanus* and is rather slender; the exognath exceeds a little basal $^2/_3$ of the proximal joint of the endognath. First pair of legs are subequal, almost smooth, and exceeds the tip of the scaphocerite with lengths of the chela and a part of the carpus. The merus and the carpus are provided with some spinular tubercles on the

upper and the lower margins; chela inverted in position, compressed and the finger is about $^3/_4$ as long as the palm; cutting edge nearly straight, not gaping. Second leg slender, somewhat longer than third leg; the carpus is divided into five articles, in which the proximal is the longest, the terminal the next in length and the intermediate ones are subequal in length, and each is a little shorter than the terminal one. The chela of this leg is nearly as long as the terminal three carpal articles altogether. Third and fourth legs similar in feature as well as in size, and distinctly stouter than second; merus with a spinule on the inferior margin, propodus with some spinular setae. Last leg a little more slender than the preceding, no spinule on the merus, on the inferior margin of the propodus there are some short hairs near the distal end. All the ambulatory legs but the last one are provided with epipodites on the bases.

Abdomen excluding the telson nearly as long as 2 times of carapace; surface smooth, laterally compressed and dorsally rounded. The telson is a little shorter than the lengths of the fifth and the sixth abdominal somites; width at the anterior end is about 2 times of that at the posterior margin. Uropodial appendage shorter than that of *B. granulimanus*, but distinctly exceeds the end of the telson.

Genus *Synalpheus* Bate

Synalpheus japonicus n. sp.

Fig. 3.

One ovigerous female was collected by Mr. S. Murayama on June 20, 1934. The species is rather small, and the body is about 20 mm long.

Rostrum broad and short, shorter than 2 times the width at the base and reaches the distal end of the basal peduncular joint of the first antenna; the lateral margin shows almost straight line in the dorsal view. The lateral spines are broader than the rostral spine, and a little shorter than this; these are almost horizontal, but directed slightly downwards. Viewing from above, these lateral spines appear to be slightly curved inwards.

The peduncle of the first antenna is somewhat shorter than 4 times the width of the second joint at the distal end; the relative proportions between the visible part of the first joint and the following two joints are as $3 : 2 : 2$; the stylocerite is acuminate and almost extends to the distal end of the second peduncular joint. In the second antenna, inferior margin of the basal joint is armed with a spine shorter than the stylocerite; the scaphocerite has a nearly straight spine, distinctly exceeding the end of the stalk in the right side, but in the left side it is abnormally shorter in the specimen. The stalk of this second antenna is $3^3/_4$ times longer than wide, reaching the extremity of the peduncle of the first antenna.

The third maxilliped, which has the terminal joint long and exceeds the end of the peduncle of the first antenna, is armed with about six spinular
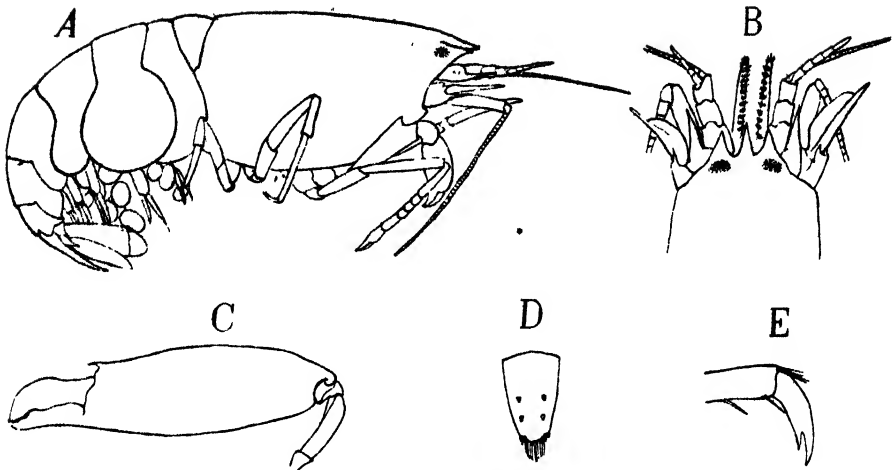
Fig. 3. *Synalpheus japonicus* n. sp.
    A.   Entire animal, view from right side. (×4)
    B.   Frontal and antennal region of the carapace, showing distal parts of the
         third maxillipeds between the first antennae, dorsal aspect. (×6)
    C.   Larger cheliped. (×4)
    D.   Telson, dorsal aspect (×4)
    E.   Dactylus of third leg. (ca. ×16)

processes near the distal end and ten or eleven bundles of setae on the inner
margin.   In the larger cheliped, the merus is about 2 times as long as wide,
the upper margin terminates in a small spiniform tooth and is about $1^1/_5$
times as long as that of the smaller cheliped; and in the latter the merus
is $2^1/_4$ times as long as wide.   The larger chela has the palm a little less
than $2^2/_3$ times the length of the finger, while in the smaller one the ratio
between these is about $3:2$.   The upper margin of the palm terminates in
a small pointed tooth in the larger cheliped, while in the smaller one such
a pointed tooth is not noticeable.   The second leg is moderate in width;
the carpus five articulate; the first article is the longest and about $^5/_6$ as
long as the remaining four articles; the terminal one is about as long as
two of the three intermediate articles, which are almost subequal in length.
The third leg has the ischium and the merus compressed and unarmed.
The merus is about 2 times as long as the carpus, which is $^3/_5$ as long as
the propodus.   The dactylus, which is armed with two pointed hooks, is
about $^1/_5$ as long as the propodus.   The fourth leg is shorter than the third,
but similar in feature with this; the dactylus has the ventral hook very
small.   The last pair of legs of both sides are unfortunately missing in the
specimen.

Abdomen $1^2/_3$ as long as carapace, and dorsally rounded.   Telson, which
has its posterior angle obtuse, is slightly longer than $1^1/_2$ the width at the
base and a little longer than 3 times the width at the posterior margin.   On
the dorsal surface there are two pairs of spinules, which are short and rather

stout. Of two pairs of spinules at the postero-lateral angle, the inner ones are a little longer than 2 times the length of the outer.

The eggs are rather large and few in number, ellipsoid in shape, its major diameter about 0,75 mm.

Family Palaemonidae Borradaile

Subfamily Pontoniinae Kingsley

Genus *Palaemonella* Dana

Palaemonella spinulata n. sp.

Fig. 4.

One female was collected by Mr. S. Murayama in January 1934.

Body rather robust. Rostrum nearly straight, a little shorter than the rest of carapace, armed with seven teeth above, of which proximal two are behind the orbital crescent and the terminal one is subterminal; there are two teeth on the inferior margin. A supraorbital, an antennal and a hepatic tooth, but pterygostomian angle rounded. Eye rather stout pedunculate. Peduncle of first antenna does not reach the end of rostrum, proximal joint long and broad with a short stylocerite; succeeding two joints subequal in length in lateral view, but in the ventral view the terminal one is the shortest.
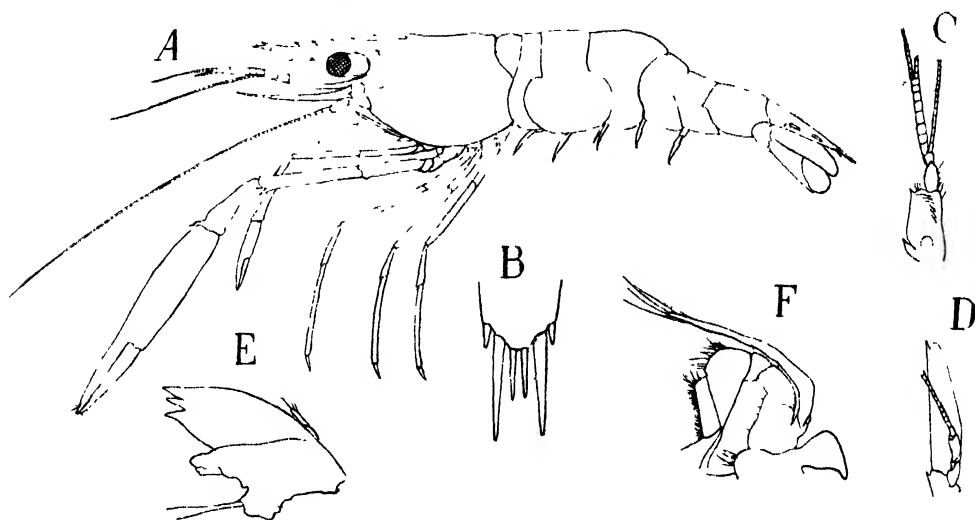
Fig. 4. *Palaemonella spinulata* n. sp.
A. Entire animal, view from left side. (×6)
B. Terminal end of telson, dorsal aspect. (ca. ×15)
C. First antenna. (×6)
D. Second antenna. (×6)
E. Mandible. (ca. ×18)
F. Second maxilliped. (ca. ×18)

Outer flagellum stout at the base, from eighth article arises a short branch in four or five articles. Inner flagellum longer and more slender than outer. Basal joint of second antenna with a short spine at the outer distal angle; peduncle rather short, scarcely reaches the end of eye; scaphocerite exceeds the end of rostrum, its outer margin nearly straight, terminally pointed and exceeds the blade. Mandible consisting of two parts with a slender palp in two joints. Endognath of second maxilliped with short hooked setae on the inner margin of the terminal joint and some long setae at the inferior corner of the distal two joints; no podobranchiae. Third maxilliped, reaching the end of the proximal peduncular joint of first antenna, rather slender, its exognath exceeds a little the end of the antepenultimate joint of the endognath. The first leg exceeds the end of the scaphocerite by more than the length of the chela; the carpus is a little longer than the merus or the chela; the latter two are subequal in length. Second leg very strong and reaches the end of the rostrum by the end of the merus; merus with a pointed tooth on the inferior margin near the extremity; carpus nearly as long as $^2/_3$ of merus, terminally inflated and armed with a tooth at the upper corner; chela stout and long, palm 2 times as long as carpus and about $1^1/_2$ times as long as finger. Posterior three pairs of legs similar in feature as well as in length; they are slender and unarmed; dactyli simple.

Abdomen $1^1/_2$ times as long as carapace including rostrum. Sixth abdominal somite a little longer than width. Telson about $1^2/_3$ as long as the sixth somite, with two pairs of rather strong spinules on the dorsal aspect and three pairs of spines on the posterior margin. Pleopods rather weak and short. Sixth abdominal appendage or the outer plate of the rhipidura rather broad and exceeds a little the end of the telson.

The species is nearly allied with *P. tenuipes* Dana (1853, p. 582, Pl. 38, Figs. 3a–d) and *P. longirostris* Borradaile (1815, p. 210) etc., but it is easily distinguishable from all these in the longer chela and in the presence of supraorbital spine. The latter fact is extraordinary for this genus, although Dr. S. Kemp already noted the presence of a small angular prominence on that place in his species *P. vestigialis* (Kemp. 1922, p. 123, Pl. 3, Fig. 2.).

Genus *Anchistus* Borradaile

Anchistus misakiensis n. sp.

Fig. 5.

One specimen was collected by Mr. Y. Ohsima in February 1934 inside of a bivalve, *Amusium japonicum*.

Body rather robust and its surface smooth. Carapace about $^5/_6$ as long as abdomen. Rostrum shorter than $^1/_2$ of carapace, distally slightly descending; upper and lower margins entire and the extremity minutely notched. Carapace dorsally rounded, with an antennal and a pterygostomian tooth.

Eye-stalk rather large. Peduncle of first antenna exceeds the end of

rostrum by the lengths of terminal joint and a part of second joint. Basal peduncular joint $1\frac{1}{2}$ as long as succeeding two joints altogether. Outer flagellum broad at base and branched from third article: in the branches the inner three- and the outer nine-articulate. Inner flagellum longer than outer, about sixteen articulate. Second antenna with scaphocerite of rather large size; peduncle exceeds a little the middle of the scaphocerite. Mandible divided into, two parts and without palp. Basal lobe of second maxilla reduced.
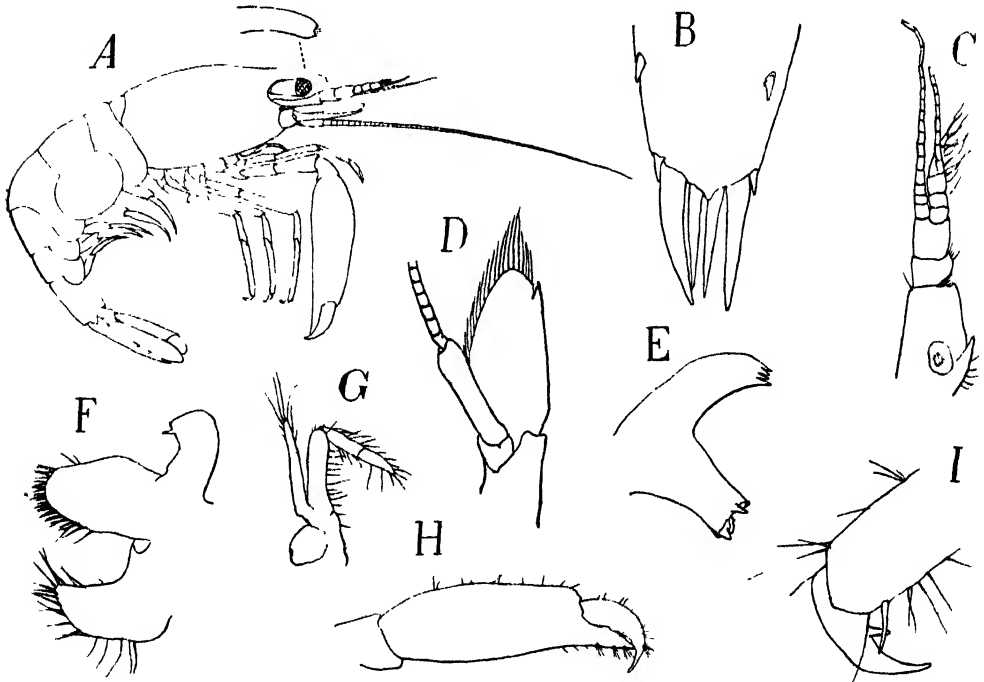
Fig. 5. *Anchistus misakiensis* n. sp.
A. Entire animal, view from right side. ($\times 8$)
B. Terminal part of telson, dorsal aspect. ($\times 64$)
C. First antenna of right side. ($\times 16$)
D. Second antenna of left side. ($\times 16$)
E. Mandible. ($\times 64$)
F. First maxilla. ($\times 64$)
G. Third maxilliped. ($\times 28$)
H. Chela of second leg. ($\times 16$)
I. Tip of third leg. ($\times 28$)

Maxillipeds with exopodites of rather degenerated conditions; antepenultimate joint of third maxilliped not much dilated. First leg exceeds the end of scaphocerite; chela about $\frac{2}{3}$ as long as carpus. Second leg strong; right one somewhat larger than left. In the right leg, the carpus is nearly $\frac{1}{2}$ as long as merus, and the palm is 3 times as long as the merus or the movable finger of the chela; this finger considerably exceeds the tip of the immovable one.

Posterior three pairs of legs similar in feature as well as in size; dactyli hooked and each has a proximal tooth.

Abdomen dorsally rounded. Sixth somite about ³/₅ as long as telson. The uropodial appendages exceed a little the tip of the telson, which is dorsally rounded, provided with two pairs of spinules on the dorsal aspect and three pairs on the distal margin.

Dimensions of the specimen:

Total length, from the tip of rostrum to the end of telson	8,5 mm
Length of carapace, excluding rostrum	2,5 ″
Length of rostrum	1,05 ″
Length of chela of second leg (of the right side)	2,8 ″

Colour in life almost translucent white and some numbers of brownish red marks on the carapace and abdomen as well as on some appendages.

No species of this genus has hitherto been known from Japanese waters.

Tribe Galatheidea

Family Galatheidae Dana

Genus *Galathea* Fabricius

Galathea longirostris n. sp.

Fig. 6.

One female was collected by Mr. Y. Ohsima on November 22, 1933.

Rostrum very long and broad, somewhat longer than ³/₄ the rest of carapace; its dorsal surface nearly flat or rather longitudinally furrowed and the lateral margins are armed with seven teeth, which are as indistinct as those of *G. paucilineata* Benedict (1902, p. 241), the ventral surface is provided with a longitudinal carina, which is obtuse but distinct. On the dorsal surface of the carapace there are about ten or eleven transverse lines, which are mostly continuous in whole width of the carapace, and each of the lines is connected with the tooth on the lateral margin of the carapace, therefore the teeth are ten or eleven in number on each side, but some posterior ones are indistinct. There is no spine on the dorsal surface of the carapace. The specimen is not well preserved and the abdomen is shrunk.

The eye reaches proximal ¹/₃ of the rostrum. The basal peduncular joint of the first antenna is stout and armed with three pointed teeth at the extremity; succeeding two joints are distinctly narrower than the basal; the outer flagellum is five articulate, while the inner is about eight articulate, stouter than the outer at the base and thickly fringed with long setae on its outer margin. In the peduncular joints of the second antenna, the proximal one is distally pointed on each of outer and inner side, and the next is pointed on the inner side, while the third is unarmed. In the third maxilliped, the proximal joint of the exognath almost attains the level of the distal end of the merus of the endognath. In the figure 6 E, the endognath is distorted at the merus, which is armed with two strong teeth on the inner margin;
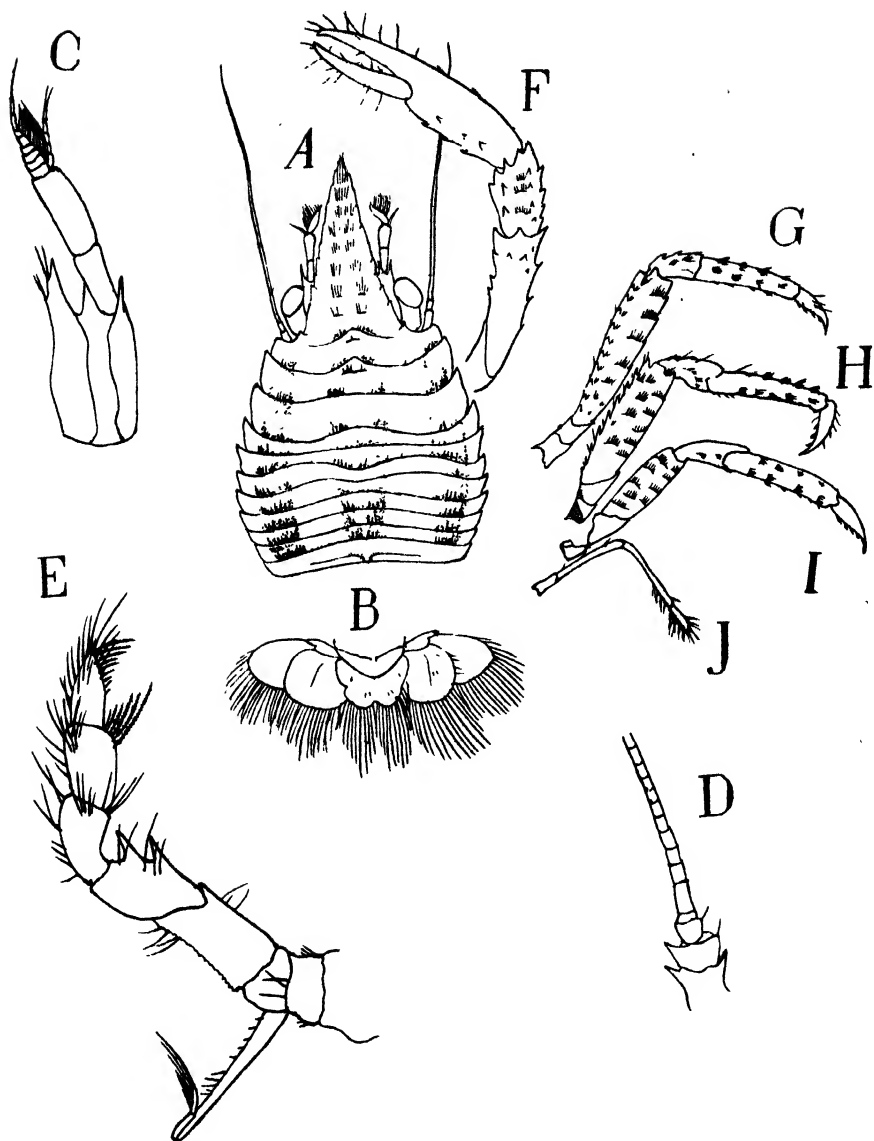
Fig. 6. *Galathea longirostris* n. sp.
A. Carapace with eye and two pairs of antennae, dorsal aspect. (×10)
B. Rhipidula, dorsal aspect. (×10)
C. First antenna. (×30)
D. Second antenna. (×30)
E. Third maxilliped. (×30)
F. Right cheliped. (×10)
G. Second leg. (×10)
H. Third leg. (×10)
I. Fourth leg. (×10)
J. Fifth leg. (×10)

succeeding three joints are unarmed. The right cheliped is much larger than the left; the latter seems to be abnormally small; the former is a little longer than the carapace including the rostrum, and the merus, the carpus and the palm are armed with several numbers of pointed teeth on the dorsal and the outer surfaces. Second leg longer than the succeeding pair of legs, successively decreasing in length to the last pair. Meri and carpi of second and third legs with spinular teeth on their anterior margins, while those of fourth leg toothless. The teeth on the merus of the second leg are ten or eleven in number and eight in the third leg, while the teeth on the carpus are three in both of the legs. The last leg is very weak; the carpus is a little longer than the merus, the latter is about 2 times as long as the propodus, which bears many soft hairs; the dactylus seems to be degenerated. Rhipidura unarmed, its surface almost smooth and fringed with long setae on the posterior margins.

Colour in life dorsally pale yellow with three longitudinal brownish bands.

Tribe OXYSTOMATA

Family LEUCOSIIDAE Dana

Subfamily LEUCOSIINAE Miers

Genus *Philyra* Leach

Philyra nipponensis n. sp.

Fig. 7.

One immature female was collected by Mr. S. Murayama in April 1935.

Nearly allied to *Philyra tuberculosa* Stimpson (1858, p. 159; 1907, p. 153, Pl. 18, Fig. 5; Balss, 1922, p. 130). Carapace slightly longer than broad, front almost $'/_7$ as wide as carapace. No hairs on frontal margin nor on external maxilliped. Granulations of carapace and chelipeds almost coinside with the description of Stimpson, but a granulated line on the inner surface of the hand almost parallel with the inferior margin. (in *P. tuberculosa* hand without granulated lines within). The abdomen of the female is distinctly divided into seven somites; in these somites the first is very short, successively increases in length to the sixth, and the terminal one is nearly as long as the fifth somite. Speaking of the widths of these somites, the first is much narrower than the next, from the latter they gradually increase to the fifth; the seventh is the narrowest. The surfaces of these somites excepting the first and the terminal ones are provided with some flattened granules. Not only these different features of the abdomen and other respects described above, but the absence of the ciliated line of the outer maxilliped parallel to the inner margin suggest us the species to be different from *P. tuberculosa*. On the other hand the species seems to be allied to *P. kanekoi* Sakai (1934, p. 286, text-fig. 4), but in the latter species the hepatic or the pterygostomian angle is not well developed and the granulation of the feet is evidently more prominent.
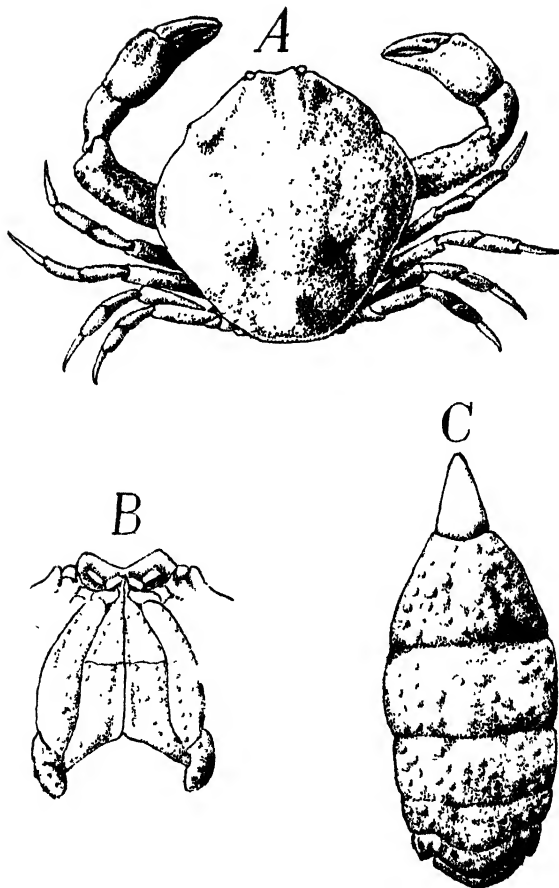
Fig. 7. *Philyra nipponensis* n. sp.
    A. Entire animal, dorsal aspect (×5)
    B. Antennal and buccal region, ventral view (×10)
    C. Abdomen of the female (×10)

Dimensions of the specimen :
    Length of carapace ....7,2 mm
    Width of carapace ....7,0 ″
    Length of cheliped (in left side)
    Length of merus ....3,6 ″
    Length of palm....................................1,8 ″
    Length of movable finger ....2,1 ″

Tribe CANCRIDEA

Subtribe OXYRHYNCHEA

Family PARTHENOPIDAE Miers

Subfamily EUMEDONINAE Miers

Genus *Harrovia* Adams & White

Harrovia elegans de Man

Fig. 8.

de Man, 1887, p. 21. Pl. 1, Figs. 5, 6; Urita, 1936, p. 30; Sakai, 1932, p. 54. *Harrovia japonica* Balss, 1921, p. 177; 1922, p. 136, Figs. 8, 9.

One female. The specimen is probably referable to the present species, but some differences are noticeable in this from the description and the figures given by the original author. On the antero-lateral margin of the carapace there are two granular plates, which are closely in contact with each other on the margin, leaving a round hole between the plates a little retreated from the margin. The lateral two teeth of the carapace are prominent (anterior one of the right side has been broken in the specimen). The dorsal surface of the carapace is densely hairy, under the hair a pair of rather prominent but rounded lobes are noticeable on the gastric region; on the anterior part of the branchial region there is a prominence on each side.

The chelipeds of the female are subequal and their surfaces are granular; the merus is armed with one or two spinular tubercles near the base of its anterior margin; the carpus is unarmed; the palm, which is longer than 2 times the length of the finger, is provided with two shallow longitudinal furrows near the upper border one on each side of this border, and with a round tubercle at the base. In the succeeding four pairs of legs, the meri are provided with six rarely seven spinular teeth on their upper margins and the terminal one is the most prominent, and the anterior leg is the longest of all and the most slender. The dactylus of the first leg is almost as long as the propodus, while those of the posterior three legs are rather robust and a little shorter than the propodi.

The type specimen is in young stage. Difference in the features especially of the carapace by the different authors, I think, is due to the gradation of growth.

Dimensions of the specimen:
Length of carapace ....12,2 mm
Width of carapace (distance between tips of
   epibranchial teeth) ....18,0 ″
Length of left cheliped: Merus............. .. .... 9,0 ″
                            Carpus .... 5,5 ″
                            Palm ....10,3 ″
                            Dactylus........ .... 5,0 ″
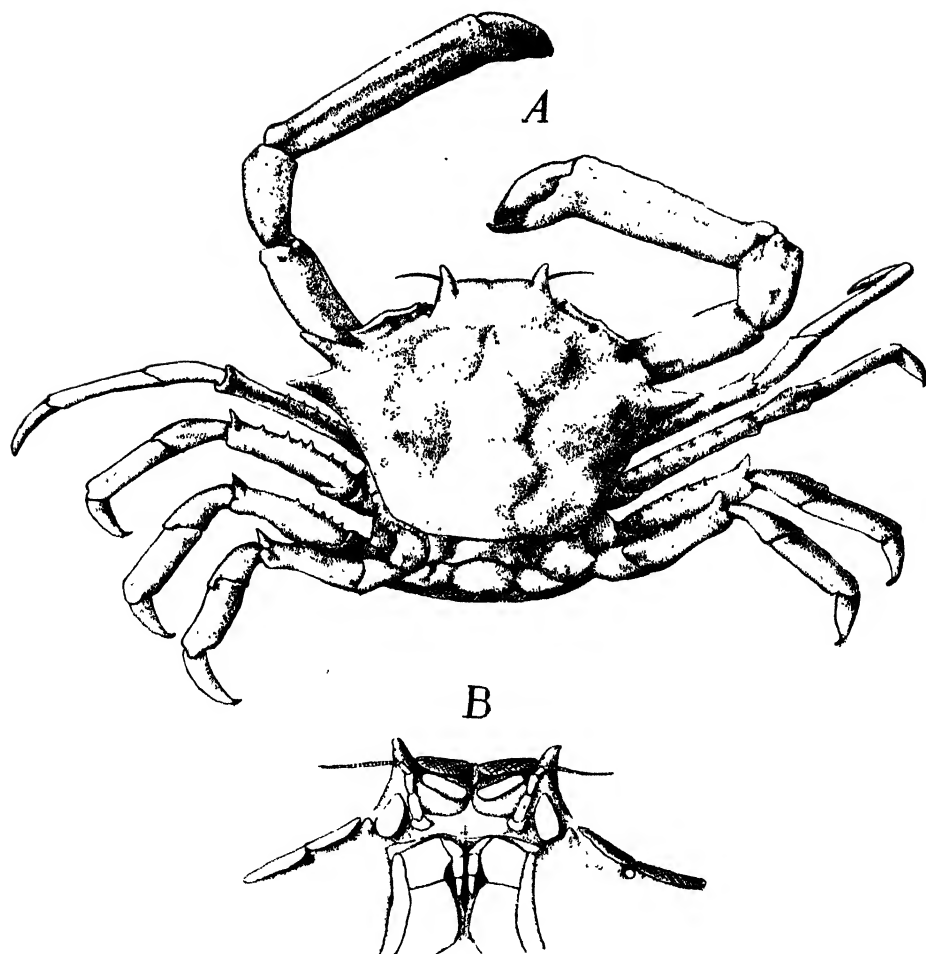
Fig. 8. *Harrovia elegans* de Man.
  A. Entire animal, dorsal aspect. (×3)
  B. Frontal antennal region, ventral aspect. (×4½)

Subtribe BRACHYRHYNCHEA

Family CANCRIDAE Alcock

Subfamily THIINAE Alcock

Genus *Kraussia* Dana

Kraussia quadriceps n. sp.

Fig. 9.

One male specimen was collected by Mr. Y. Ohsima.
Carapace a little broader than long. The front, which is about ¼ as

wide as the carapace at the broadest point, is distinctly four lobed. The lateral margin of the carapace is minutely dentate, and near anterior $^1/_3$ there is a notch to form a distinct tooth. Dorsal surface moderately convex, nearly smooth, but with shallow ripple-marked sculptures. A medial groove on the anterior part of the carapace is continuous from the median notch of the front. Thomb of chela normally well developed. More or less long hairs are provided on the margin of the carapace as well as on the upper and the lower margins of the legs.
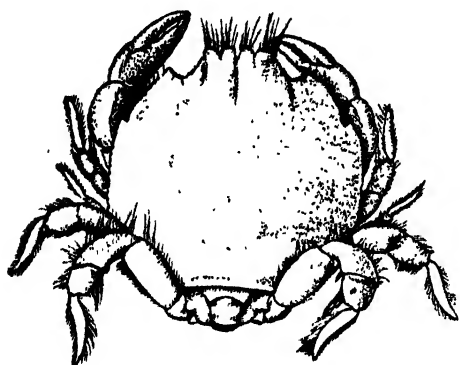
This species is distinguishable from other members of this genus by the following features:

The front is divided into four distinct lobes of almost equal width; and the lateral margin of the carapace is provided with one distinct tooth.

Fig. 9   *Kraussia quadriceps* n. sp. (×3)

Dimensions of the specimen:

Length of carapace ....10,7 mm
Width of carapace.................... .   . .. 11,3 ''
Width of front .... 3,3 ''

Family GONEPLACIDAE Ortmann
Subfamily RHIZOPINAE Stimpson
Genus *Mertonia* Laurie
Mertonia lanka Laurie
Fig. 10.

Laurie, 1906, p. 424, Pl. 1, Fig. 11; Rathbun, 1910, p. 342, Pl. 2, Fig. 4; Tesch, 1918, p. 217, Pl. 16, Fig. 2a.

One male and one female were collected by Mr. Y. Ohsima in December 1932. The female is distinctly larger than the male.

Dimensions of specimens:	male	female
Length of carapace in median line	4,9 mm	5,9 mm
Width of carapace at the broadest point	5,1 ''	7,7 ''
Width of front	1,1 ''	1,7 ''
Distance between the external orbital angles	3,2 ''	4,0 ''

In the shape of the carapace there are some differences in the present two specimens from Misaki: i. e., in the male the lateral margin of the carapace is more divergent backwards than that of the female, and the broadest point

lies near the bases of the last pair of legs, while in the female it lies near the middle of the lateral margin. On the dorsal surface of the carapace there are some numbers of small depressions near the margins, but on the cardiac region instead of the depressions there are three small markings. The anterior margin of the merus of the third maxilliped is somewhat sinuated.

The third abdominal somite is a little narrower than the basal in the male; and the latter somite occupies almost $\frac{1}{2}$ the breadth of the sternum of the last thoracic somite, measuring at the visible broadest point; the fourth
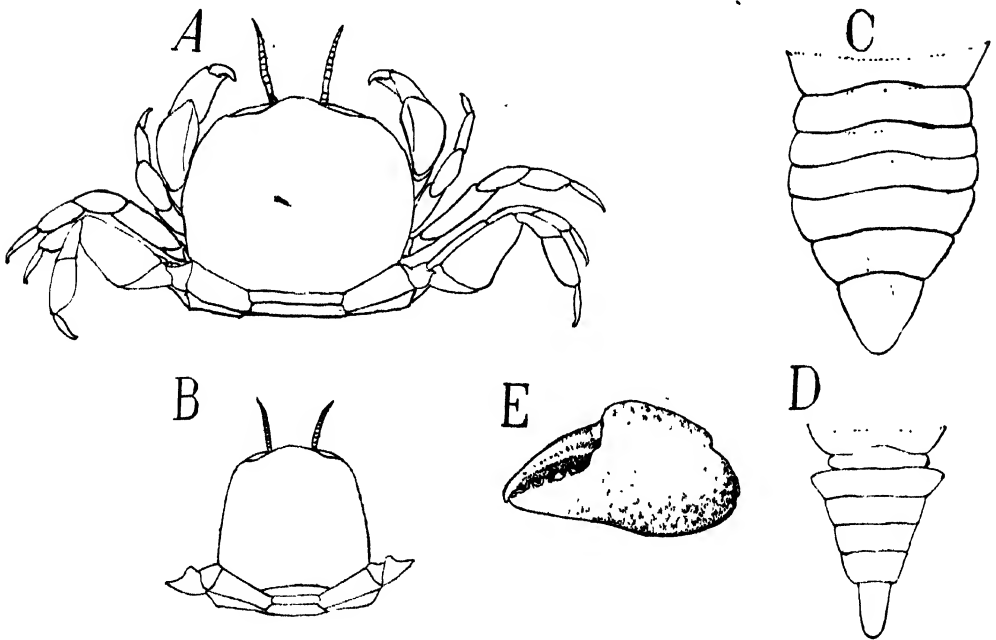
Fig. 10. *Mertonia lanka* Laurie.
- A. Entire animal of female. ($\times 5$)
- B. Dorsal aspect of male, appendages omitted. ($\times 5$)
- C. Abdomen of female. ($\times 10$)
- D. Abdomen of male. ($\times 10$)
- E. Chela of female of left side. ($\times 10$)

somite is nearly as long as the fifth, and the terminal one elongates, a little longer than $1\frac{1}{2}$ times of the width of the base. In the female, the basal abdominal somite is slightly narrower than $\frac{1}{2}$ of the breadth of the sternum of the last thoracic somite; the second is longer than the third, from which succeeding somites gradually increase in length, and the terminal is the longest but somewhat shorter than the breadth at the base.

Distribution: Ceylon; Gulf of Siam; Aru Islands. Occurrence from Japan is an interesting fact from the view point of the geographical distribution.

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8. Contribution to the Knowledge of a Nudibranch, Okadaia elegans Baba[1]

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(With 34 Text-figures)

CONTENTS

Among the various Opisthobranchs collected and studied by me on the Japanese coast, *Okadaia elegans* Baba is the most interesting object for study because of its (1) aberrant external form without gills, (2) simple organization for the most part and (3) direct development where the free-swimming stage is completely obliterated, the larva hatching out directly from each egg-capsule. It is hoped that by the present study, undertaken as a correction and an extension of my previous papers (Baba, 1930–1931), various informations regard-

ing the systematic, morphology and embryology of this Nudibranch might be
corrected and supplemented. While there is the advantage of facility of examin-
ing abundant material practically throughout the whole year, this animal has
presented difficulties in being very small and easily contractile. Two general
methods of observation have been followed: (1) the dissection of living animals
under the microscope, and (2) the study of serial sections. For the latter the
best method of preparation is as follows: the animals after Bouin fixation are
washed in alcohol, cleared in toluol, and embedded in paraffin in the usual
way. The sections are stained for general study in Delafield's haematoxylin
in combination with eosin, and for cytological study in iron-alum haematoxylin
of Heidenhain. Osmic acid and its allies (Flemming's fluid, Champy's fluid)
have proved very useful with sensory cells, plasma cells and gland cells. When
needed, Champy-Kull's method, Biondi-Ehrlich's tricolor staining, neutral red,
toluidin, thionin and methylene blue have also been tried.

Before proceeding to the main body of the description, I wish to express
my grateful acknowledgment to Dr. Hiroshi Ohshima, Director of the Labora-
tory, for affording me facilities for work, for advices, and for the loan of some
indispensable literature. I am much indebted to Dr. Nils Odhner of the
Riksmuseum, Stockholm, for his kind informations.

I. Systematic

Okadaia elegans Baba

Okadaia elegans Baba, Venus, vol. 2, no. 2, 1930, pp. 48–50, pl. 2, figs. 11–14.—Tateyama; Baba,
    Annot. Zool. Japon., vol. 13, no. 2, 1931, pp. 65–74, text-figs. 1–4; pl. 5, figs. 1–4; pl. 6, figs.
    1–3; pl. 7, figs. 1–15.—Tôkyô Bay; Baba, Journ. Fac. Sci. Hokkaidô Imp. Univ., ser 6, Zool.,
    vol. 4, no. 3, 1935, p. 120.— Akkeshi Bay.

DISTRIBUTION IN JAPAN: Tomioka, Toba, Zushi, Eno-shima, Tateyama,
Mutsu Bay and Akkeshi Bay.

Body small, less than 5 mm in length, limaciform, light orange-yellow;
head and foot not carinate; rudimentary oral tentacles represented by special
sensitive areas on lateral sides of the mouth; rhinophores simple, contractile,
but without sheaths. Mouth slit-like. Foot narrow, truncated in front, bluntly
pointed behind. Gills entirely wanting. Anus and nephroproct slightly shifted
to the right of the mid-dorsal line, about one-third of the way back from the
head; genital orifices present obliquely in front of the anus, upon the right
side of the body. Jaw-plates wanting. Radula formula for one row 3. 0. 3;
1st lateral tooth roughly hamate, with 4 spiny denticles on the top; 2nd lateral
tooth larger, hamate, simple; 3rd lateral tooth plate-like. Liver divided into
3–4 lobes; rectum with an anal organ; true heart not enclosed within a peri-
cardium; kidney simply elongated; ureter accompanied by an accessory renal
gland; reno-coelomic canal (reno-pericardial canal) present. Testes 2–3; ovaries
5–6; protandrous. Development direct; eggs develop into youngs while within
egg-capsules.

The present species resembles *Vayssierea caledonica* Risbec[1] in the general form and coloration; in the absence of jaw-plates; in the general character of the radula; in the position of the anus; in the divided liver; in the separated gonads; in the armed vas deferens; and in the direct development. The latter form, of which our present knowledge is still unsatisfactory, seems to differ from the former in a set of features such as carinate head, carinate tail, papillate mouth, and anus surrounded by ciliated mamelons representing rudimentary gills. Moreover it is characterised by the radula formula 2. 0. 2, heart enclosed within a pericardium, proterogynous gonads, veliger with a bilobed rudimentary velum, and young with three gonads, one female and two male.

Both the present species and *V. caledonica* Risbec differ much from *Fucola rubra* Quoy & Gaimard[2] in having a pair of separate rhinophores a short distance behind the anterior end of the head (in *F. rubra* the rhinophores are connate, lying at the extreme anterior end of the head).

It is suggested here that *Trevelyana felis* Collingwood, though regarded by Collingwood himself[3] as an immature species of *Trevelyana (Gymnodoris)* and by Pruvot-Fol (1933, 1934)[4] as belonging to the little-known genus *Fucola*, might be a tiny, gill-less, scarlet-tinted Dorid, closely allied to either of the species, *V. caledonica* Risbec or *O. elegans* Baba.
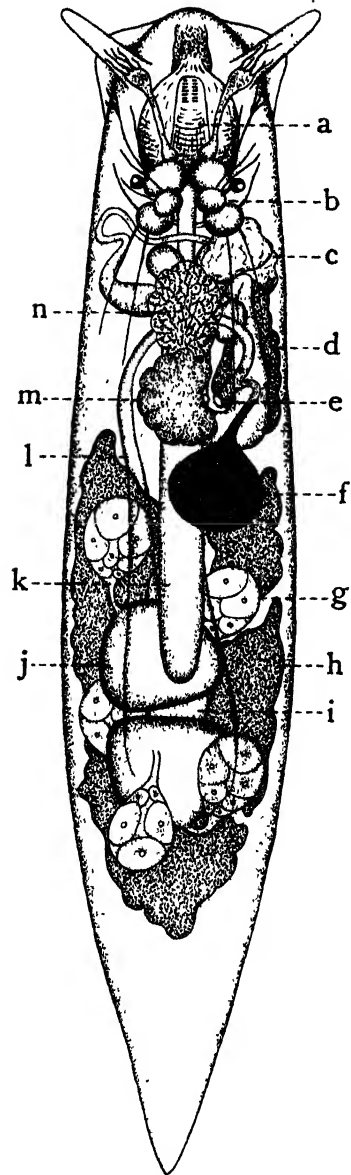
Fig. 1. General dissection of full-grown specimen (about 4–5 mm long), from dorsal side. *a.* pharyngeal bulb, *b.* central nervous system, *c.* genital orifices, *d.* accessory genital organs, *e.* anus, *f.* anal organ, *g.* ovary, *h.* liver, *i.* stomach, *j.* testis, *k.* kidney, *l.* intestine, *m.* accessory renal gland, *n.* heart.

[1] Risbec (1928), pp. 29–32, 290–292, pl. 12, fig. 8; text-fig. 98.— New Caledonia; (1930), pp. 94–97, figs. 2–3.

[2] Quoy & Gaimard (1833), p. 321, pl. 24, figs. 21–22.— Atlantic Ocean.

[3] Collingwood (1881), p. 134, pl. 10, figs. 12–14.— Makung (Pescadores) & Slut Island (China).

[4] Pruvot-Fol (1933), p. 401; (1934), p. 77.

Family Vayssiereidae Thiele, 1931

Vayssiereidae Thiele, Handb. syst. Weicht., Teil 2, 1931, p. 430.
Okadaiidae Baba, Annot. Zool. Japon., vol. 13, no. 2, 1931, pp. 64–65.

Body very small, limaciform; rhinophores simple, not retractile into sheaths; gills wanting; anus on the back; jaw-plates absent; radula formula for one row 2. 0. 2 or 3. 0. 3; testes and ovaries separated; vas deferens armed; development direct.

The affinities of *Okadaia* are still undefined, but the possibilities are that the genus comes near to *Vayssierea*. Risbec (1928) regards *Vayssierea* as belonging to the Limapontiidae by virtue of the limaciform body without gills and the mode of development. But, as the radula is not of the Sacoglossan type, Thiele (1931) places the genus within the holohepatic Nudibranchia, thus establishing for it a new family, Vayssiereidae. And in favour of this view the Okadaiidae should be withdrawn.

II. Ecology

1. Habitat

The present species frequents the intertidal zone, preferring shores where the sea-water is clear, still and suitably warm, and feeds upon tiny *Spirorbis* spp.[1] which cover undersurfaces of stones. When stomach contents are examined under the microscope, undigested fragments such as setae are often found. Towards the beginning of October the animals gradually come ashore and begin to lay eggs underneath stones. They are most abundant from January to April, when pairing and spawning most actively take place, and decrease in number towards summer. From the eggs hatch out free-creeping youngs about 0.6 mm long, having passed the veliger stage while still in egg-capsules. We find youngs in various stages of development on the shore. They may mature in one season.

In captivity the animals are at first very active, continually creeping around on the base and sides of the aquarium. They often float upside down hanging on the undersurface of the water, in which position the foot is usually expanded flat on the surface. Pairing and spawning rarely take place in the aquarium. They do not stand confinement well, becoming sluggish and die within a few days.

The animals have been known to occur along the Pacific Ocean side of Japan, from Tomioka (Amakusa) to as far north as Akkeshi (Hokkaidô).

2. Parasites

Copepoda, Trematoda, Nematoda and Cestoda have hitherto been recorded to live parasitic on various Opisthobranchs (Hecht, 1896; Born, 1910; Risbec,

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[1] According to Mr. S. Okuda the *Spirorbis* spp. consist of *nipponicus* Okuda and *spirillum* (Linné).

1928; and others). Here are described two kinds of parasites which are harboured by the present species. The commonest are Ciliates. Their shape at rest is elongate-oval, but it varies with the progression of the animal. The whole outer surface is covered with cilia. The total length measures about 35 μ. These Ciliates can freely traverse the integumental tissue, haemocoele and renal lumen. A number of encysted Nematodes are found infesting various parts of the body. A filiform Nematode, about 0.7 mm in length, was once found (Fig. 2).

Fig. 2. Living parasitic Nematode ($\times$ 100).

3. Copulation

In the present species the mutual interchange of sex-products is effected between two individuals. Copulating pairs are frequently found underneath stones, and so firm is the union that separation sometimes does not take place even though they are put into a fixing fluid. In copulation two mature individuals lie side by side, the head of one directing towards the tail of the other, and having the right edges of their bodies in close apposition. The penis sac is everted from the male orifice to form a large rolled copulatory lobe, the whole length of which is traversed by the vas deferens. The one (Fig. 3, A) of the pair applies its copulatory lobe (Fig. 3, A') to the female orifice of the other individual B, and at the same time the reverse takes place from B to A. In sections the distal end of the vas deferens is found lying close to the female orifice, but not thrust into the vagina. The sperms in the spermatocyst are ejected through the vas deferens and flow into the space between the female orifice and the distal end of the copulatory lobe. They then pass up along the oviduct and vagina, enter the spermatheca and are stored there, the heads of spermatozoa penetrating into the nutritive epithelium. A part of the sperms may visit the mucous and the albumen glands. During copulation the prostate wall exudes secretion.

4. Oviposition

A specimen in which eggs are in process of being laid has been fixed and sectioned. During oviposition the wall of the oviduct is everted and the large lumen of the mucous gland comes to face the exterior directly. Many of the primary oocytes ready for oviposition leave the ovaries, and are conveyed towards the mucous gland and female orifice. Here they are embedded in a mucous egg-band, each with an albuminoid egg-capsule. The glandular epithelia of the albumen and the mucous glands decrease considerably in height and

Fig. 3. Transverse section of copulating individuals passing through female orifice of individual A. (×120). The body of individual B is omitted in the drawing. A. Individual A with its copulatory lobe A'. B. Copulatory lobe of individual B, applied to female orifice of A. *a* accessory renal gland, *b.* anus, *c.* kidney, *d.* communication between albumen gland and mucous gland, *e.* vagina, *f.* vas deferens, *g.* female orifice, *h.* mucous gland, *i.* pharyngeal bulb, *j.* oesophagus, *k.* liver, *l.* prostata, *m.* spermatheca, *n.* intestine.

become vacuolate after copious discharge of the contained secretion. The formation of egg-capsules and egg-band is due to the albumen and the mucous glands respectively. The newly formed egg-band is so soft and viscous that it may easily be attached to any object. When hardened it becomes a broad flat band, turned sidewise, containing eggs from 3 to 23 in number (see also Baba, 1931).

III. Morphology of the Adult

1. Mantle

The whole upper surface of the body is covered with a columnar mantle epithelium in which lie sensory cells and pigment cells and through which open mucous glands. This epithelium rests upon a basement membrane followed by a loose connective framework.

1. Epithelial cell: The epithelial cells are differentiated into two types, the non-ciliated and the ciliated cells, the former being commoner than the latter. The non-ciliated cells (Fig. 4, *e*) are of high columnar form with basal nuclei and finely granular cytoplasm, and bear a thin cuticle on the free surface. The ciliated cells (Fig. 4, *f*) do not differ much from the former, except that they have denser cytoplasm and brush-like cilia. These cilia rest upon distinct basal granules lying just beneath the cuticle, while their roots may be traced below almost as far as basal nuclei.
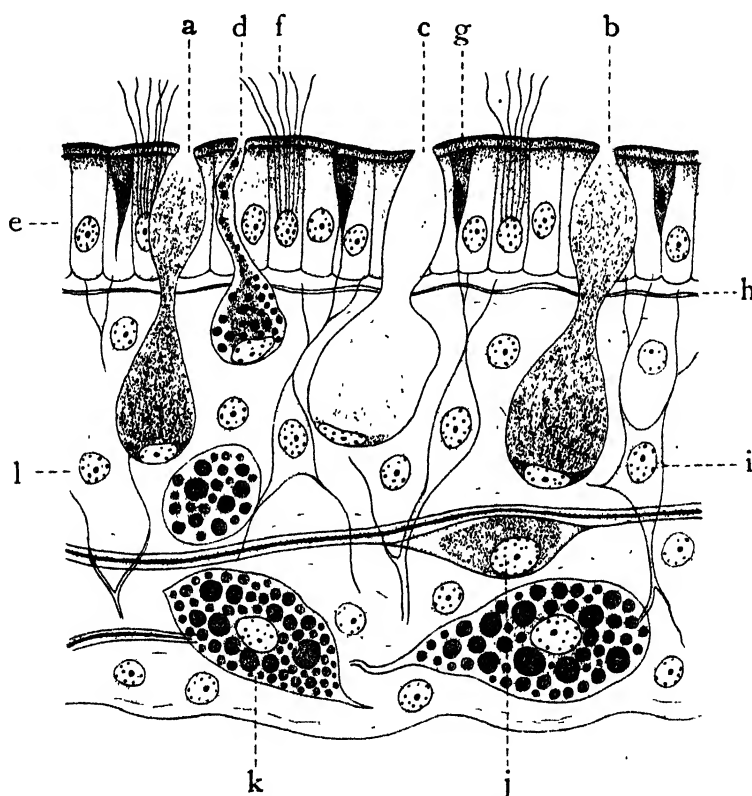
Fig. 4. Mantle integument, fixed in osmic acid (×1200). *a.* young mucous gland, *b.* mucous gland ready to secret, *c.* mucous gland after discharge, *d.* pigment cell, *e.* non-ciliated epithelium, *f.* ciliated epithelial cell, *g.* sensory cell, *h.* basement membrane, *i.* ganglion cell, *j.* muscle cell, *k.* plasma cell, *l.* connective tissue.

2. Sensory cell: The sensory cells (Fig. 4, *g*) are small and triangular, and are wedged among the superficial parts of the epithelial cells. I cannot agree with Merton (1920) who describes for *Fimbria, Tethys* and *Philine* that the sensory cells are subepithelial in position and supply processes penetrating through the epithelium.

3. Pigment cell: The pigment cells (Fig. 4, *d*; Fig. 5, *a*), with orange granules, are scattered here and there among the epithelium. They are flask-shaped, the neck of the flask forming a slender, often curved duct for the discharge from the bulbous portion. The nucleus is shifted near the bottom of each cell by means of a yellow-tinted secretion which shows special affinity for eosin. The cytoplasm of a discharged pigment cell appears to be almost colourless. The gland cells with eosinophilic contents are known from various Opisthobranchs (Born, 1910; Agersborg, 1923; and others).

4. Mucous gland: The unicellular mucous glands (Fig. 4, *a, b, c*; 5, *b*), still flask-shaped, are held down in various stages of development. The nucleus, crushed by the mass of secretion, lies near the bottom of the bulbous portion and is surrounded by a cytoplasmic mass. The neck portion of the flask enlarges in the form of a spindle, and debouches to the exterior by a circular opening through which the secretion escapes. In the fresh condition the mucus content of the gland is finely granular and colourless; in sections it stains violet with polychrome methylene blue, purple with toluidin and orange-yellow with neutral red. After discharge, the gland becomes vacuolate.
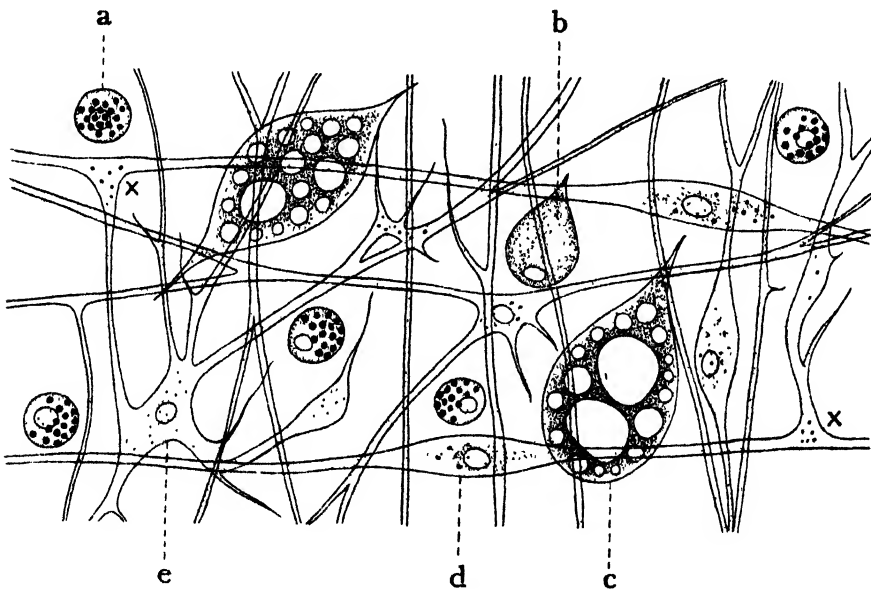
Fig. 5. Fresh mantle integument (×1200). *a.* pigment cell, *b.* mucous gland, *c.* plasma cell, *d.* muscle cell, *e.* peripheral nervous system, ×. innervation for muscle-fibres.

5. Basement membrane: The basement membrane (Fig. 4, *h*) which underlines the epithelium is thin and structureless. It is devoid of nuclei.

6. Connective tissue: The bulk of the integument is made up of loose connective tissue. The tissue cells have round nuclei and multiple protoplasmic branches by which they cling together. The connective tissue contains richly branching mantle nerves. The ganglion cells (Fig. 4, *i*) are bipolar, tripolar or often multipolar, and supply nerve fibrils to various elements of the mantle, namely epithelial cells, sensory cells, mucous glands and muscle fibres, etc. Each ganglion cell contains a nucleus surrounded by finely granular cytoplasm. When fresh it is either colourless or rarely loaded with a small number of orange granules.

The connective tissue is traversed everywhere by interwoven muscle fibres (Fig. 4, *j*; Fig. 5, *d*) which are unicellular and exceedingly elongated, and are not gathered to form bundles as in other Opisthobranchs (Born, 1910; Agersborg. 1923). A single nucleus, surrounded by a cytoplasmic mass, lies midway of the length of the muscle fibre which has a clear sarcolemma. The muscle fibres regulate the contraction and extension of the body.

The large plasma cells (Fig. 4, *k*; Fig. 5, *c*), excretory in function, are found frequently in the connective tissue. Most of them are oval with one end produced to form a fine thread by which they are suspended from other tissue elements. Often they are spindle-shaped with two ends produced into threads. The fresh plasma cells do not seem to be amoeboid, but contain spherules of various sizes. The spherules remain dark in material after osmic acid fixation and tend to be easily vacated by usual fixatives.

2. Rhinophore

The rhinophore is contractible below the surface of the mantle by means of retractor muscle fibres running between the oral tentacles and the rhinophore. The epithelium consists of ciliated cells similar to those of the mantle, interspersed among which are triangular sensory cells and pigment cells. There is a well-developed subepithelial ganglion layer (Fig. 6, *a*) which supplies on one side nerve fibrils to various epithelial elements, while on the other side it receives strong nerves from the large distal-rhinophorial

Fig. 6. Median vertical section of rhinophore (×200). *a.* subepithelial ganglion layer.

ganglion at the bottom of each rhinophore (see also Nervous system). The intense colour of the rhinophore is due to the presence of rich orange granules

in the subepithelial ganglion layer.

3. Rudimentary Oral Tentacle

The well-defined oral tentacles as seen in other Opisthobranchs are absent in the present species. But the integuments on both sides of the mouth form special sensitive areas supplied with richly branching oral nerves. They are regarded here as representing the most primitive oral tentacles. When the animal is creeping they are slightly bulged out and kept in constant motion as tactile organs feeling about in a strikingly characteristic manner. Occasionally they may be withdrawn. The lining epithelium is tall and ciliated, and contains triangular sensory cells which are connected with the underlying ganglion layer supplied by the oral nerve. The motion of the rudimentary oral tentacle is regulated by retractor muscle fibres running between this organ and the rhinophore (see also Nervous system).

4. Foot

The pedal epithelium consists of columnar cells interspersed among which are sensory cells, pigment cells and pedal glands. It is cuticulated and ciliated throughout the free surface, and there is an abrupt line of demarcation between this and the mantle epithelium. The underlying connective tissue, with abundant muscle fibres, plasma cells and ganglion cells, makes up the bulk of the pedal integument.

The pedal glands are best developed on the anterior and the lateral margins of the

Fig. 7.   Pedal integument, fixed in osmic acid (×1200).   *a.* ciliated epithelium, *b.* pedal gland, *c.* sensory cell.

foot.   Each gland (Fig. 7, *b*) is flask-shaped, with a slender duct pushing its way through the epithelium.   The bulbous portion consists of several cells

bound together by an external delicate membrane. The fresh pedal gland is filled with fine colourless granules which stain metachromatically with specific mucus stains. Occasionally there occur a few orange granules in the pedal gland. A copious supply of mucus is exuded from the pedal gland, so that the pedal sole can progress by sliding on the surface of any object. From the inner side of the pedal epithelium arise many muscle fibres which, running in various ways, serve for the locomotion of the body.

5. Digestive System

The digestive system consists of a stomodaeum; a pharyngeal bulb bearing an odontophore; an oesophagus; a stomach surrounded by 3–4 liver-lobes; an intestine; and a rectum accompanied by an anal organ. All the digestive organs, except for the stomodaeum and pharyngeal bulb, are covered with a thin external layer of connective tissue.

1. Mouth: The mouth has the form of a vertical slit lying on the ventral side of the head. The lateral areas of the mouth form rudimentary oral tentacles (see also Mantle and Sense organs). At the mouth slit the integumental epithelium turns in to form a large orange-yellow stomodaeum (Fig. 8, a) which communicates posteriorly with the pharyngeal bulb. The stomodeal epithelium (Fig. 9, b),
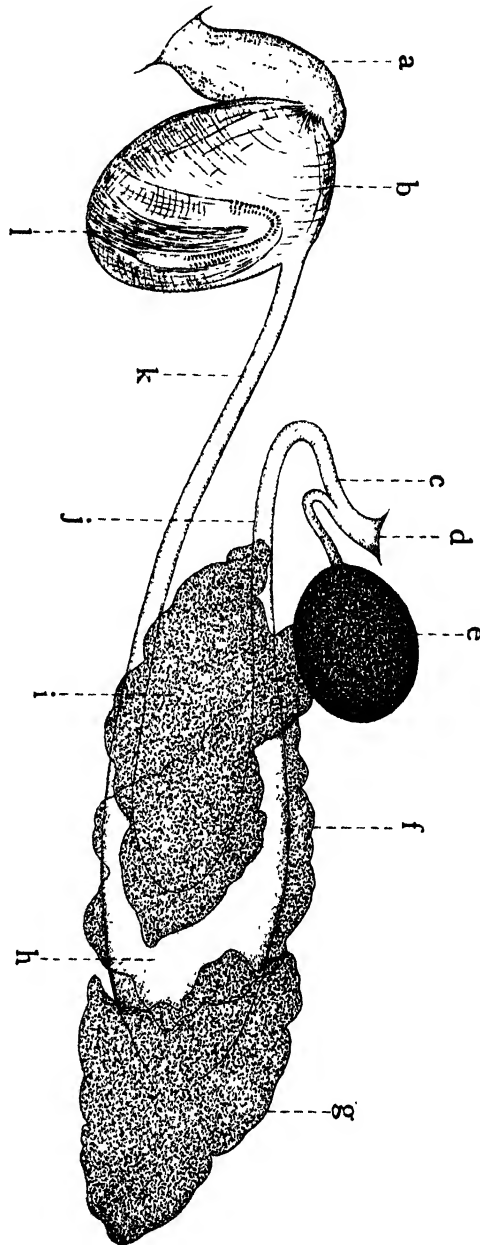
Fig. 8. Left lateral view of digestive system (×60). a. stomodaeum, b. pharyngeal bulb, c. rectum, d. anus, e. anal organ, f. right liver-lobe, g. posterior liver-lobe, h. stomach, i. left liver-lobe, j. intestine, k. oesophagus, l. odontophore.

thrown into corrugations, is made up of columnar cells, the free surfaces of which are covered with cuticle and cilia. It has triangular sensory cells and flask-shaped mucous glands. These latter, usually small in size, are especially abundant on the dorsal and the lateral walls of the stomodaeum. Posteriorly the ciliated epithelium disappears, giving place to a forward extension of the pharyngeal epithelium with thin cuticle only, the posterior part of which, however, is turned on itself to overlap the outer wall of the pharyngeal bulb at its anterior part.
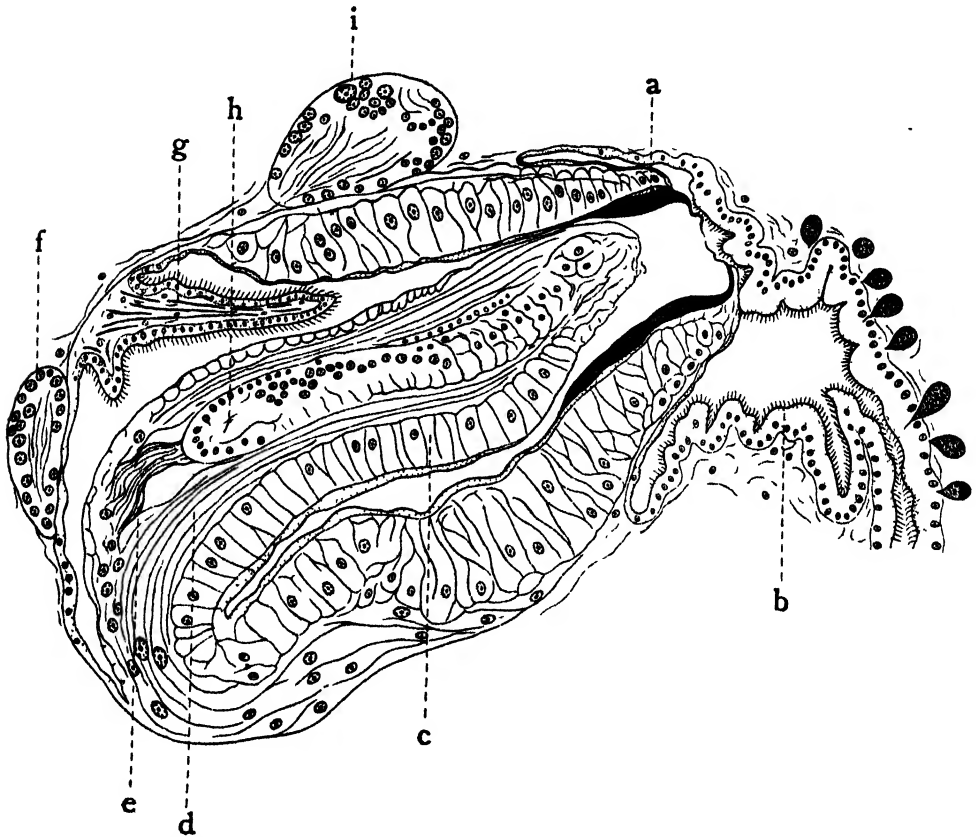
Fig. 9.   Median longitudinal section of pharyngeal bulb (×180).   a. cuticular lining, b. stomodaeum, c. odontophore, d. retractor of odontophore, e. retractor of radula sheath, f. buccal ganglion, g. pharyngeal valve, h. radula sheath, i. cerebral ganglion.

2.   Pharyngeal bulb: The pharyngeal bulb or buccal mass (Fig. 1, a), as seen in dorsal view, is roughly oval in form. Its swollen posterior end forms a cul-de-sac on the ventral side and lodges the odontophore. On the dorsal side it gives off an oesophagus, surrounded by the central nervous system. Salivary glands are entirely wanting. The pharyngeal bulb is almost colourless

and transparent, though there are sparsely-set orange granules in the wall.

The inner wall of the pharyngeal bulb is covered with a cuticle layer (Fig. 9, *a*) which thickens towards the orifice of the organ and tends to split up into a closely-set mass of hair-like structure. Excepting this cuticle there are no special jaw-plates lining the pharyngeal opening. The epithelium (Fig. 10, *a*) by which the cuticle is secreted is extremely flat, covering the whole inner wall of the pharyngeal bulb. The cells which constitute the bulk of the pharyngeal wall are very tall, columnar, and are of a muscular nature (Fig. 10, *b*). Mostly they are arranged in a layer, at right angles to the long axis of the pharyngeal bulb. Each cell contains closely-set, very fine muscle fibrils running between the base and the upper end. The nucleus lies near the base or midway of the cell and is surrounded by granular cytoplasm. The wall of the pharyngeal bulb increases in thickness as it passes backward and downward to the bottom of the organ, where a thin layer is added to the outside. In this layer long cells, rich in muscle fibrils, lie parallel to the long axis of the pharyngeal bulb. The posterior wall of the pharyngeal bulb is formed of a low non-ciliated epithelium.

The odontophore (Fig. 8, *l*; 9, *c*) arises as a fleshy cone-like projection from the floor of the postero-ventral cul-de-sac
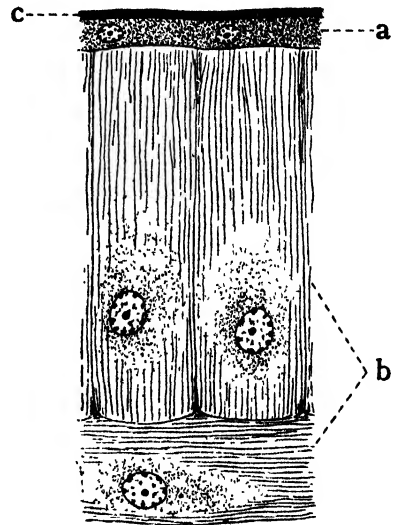
Fig. 10. Section of pharyngeal wall (×650). *a.* epithelium, *b.* cells containing muscle fibrils, *c.* cuticle.
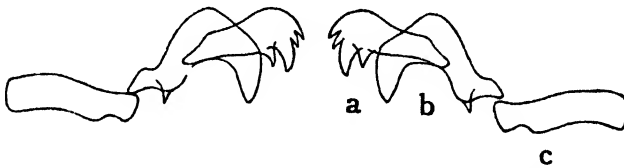
Fig. 11. A transverse row of radula (×650). *a.* 1st lateral tooth, *b.* 2nd lateral tooth, *c.* 3rd lateral tooth.

of the pharyngeal bulb. While feeding it may be partly thrust out in order to grasp *Spirorbis* spp. on which the present species feeds. The radula extends forward from the radula sheath within which it is lodged, becomes exposed at its anterior portion and abruptly turns back ventrally along the lower surface of the odontophore. It has 35–44 rows of teeth, 6 in each row. The central tooth is entirely wanting. The radula formula (Fig. 11) for one row is always 3. 0. 3. The first lateral tooth is roughly hamate and bears at its apex 4 spiny denticles, of which the next to the innermost is the largest. The 2nd

lateral tooth is larger, hamate and simple. The 3rd lateral tooth takes the form of a squarish plate.

The radula sheath (Fig. 9, h) is a delicate cellular caecum continuous distally with the low epithelium of the odontophore. It ends blindly at the point to which is attached a group of muscle fibres arising from the base of the odontophore. These fibres serve as a retractor (Fig. 9, e) of the radula sheath. The cells forming the blind end proliferate to take part in the continual growth of the radula sheath. To elucidate the formation of teeth cross sections of the radula sheath are required (Fig. 12). The lateral and the basal walls of the sheath consist of low cells. These latter are the odontoblasts which secrete a cuticular substance to give rise to teeth. The cells of the dorsal wall extend down into the lumen of the sheath, forming a longitudinal ridge. They do not appear to secrete cuticle but serve as supporting cells by fitting themselves to the upper side of the teeth. Orange pigment is included in the basal half of the radula sheath.

Fig. 12. Transverse section of odontophore (×500). a. retractor of odontophore, b. 3rd lateral tooth, c. 2nd lateral tooth, d. 1st lateral tooth, e. radula sheath, f. odontophore wall.

The well-developed muscle fibres (Fig. 9, d; Fig. 12, a) surrounding the radula sheath control the protraction and retraction of the odontophore. They arise from the base of the odontophore and run upward to the top where they terminate. Their nuclei are usually situated near the base of the odontophore.

The wall of the odontophore (Fig. 12, f) is made up of two layers of cells. The outer layer is a flat epithelium which secretes cuticle. The inner layer consists of tall columnar cells containing rich muscle fibrils. This layer is thickest at the ventral side of the odontophore, becoming thinner towards its dorsal side.

Into the pharyngeal cavity, above the odontophore, there project downward a pair of valve-like structures (pharyngeal valves) (Fig. 9, g) from the posterodorsal wall of the pharyngeal bulb. Nothing similar to these structures is recorded among Dorids. Each structure is a soft organ with a plicate surface,

covered with a columnar epithelium bearing cuticle and cilia. This epithelium rests upon a delicate basement membrane overlying the connective tissue which makes up the bulk of the organ. Triangular sensory cells are wedged among the epithelial cells; no gland cells are visible here. The appearance of this structure varies according to the action of muscle fibres, running between the base and the top of the organ. It seems probable that the valve-like structures act as sensory organs to prevent passage of objectionable particles into the oesophagus.

3. Oesophagus: The oesophageal epithelium is colourless and devoid of cilia except at the beginning of the eosophagus where the inner wall is folded and ciliated. Each epithelial cell is low and columnar, with a nucleus situated at about the middle of its height, and contains a finely granular substance which, when exuded, fills the lumen of the oesophagus. The oesophageal epithelium is thus secretory in function, and the secretion produced may partake in the digestion of food as the latter passes through the oesophagus.

4. Stomach: The stomach (Fig. 1, *i;* Fig. 8, *h*) is an ill-defined roomy colourless sac. It is continuous ventrally with the oesophagus, and dorsally with the intestine. It receives secretion from liver masses, which have 3–4 main orifices. These orifices are almost equal in diameter to the stomach itself. Near the orifices the hepatic epithelium gradually decreases in height and continues into the stomach wall, so that there is no formation of hepatic ducts. The floor of the stomach consists of a low epithelium similar to the oesophageal lining, while the epithelium forming the upper wall is tall with cuticle and cilia and continues into the intestine without any clear demarcation. The stomach epithelium itself is secretory in function and contains a fine granular substance. In sections the contents of the stomach consist of recognisable pieces of ingested *Spirorbis* spp. The undigested particles such as setae are excreted through the intestine.

5. Liver: The liver, which surrounds the stomach is divided into 3–4 lobes (Fig. 1; Fig. 8). When there exist 3 liver-lobes, the posterior one (Fig. 8, *g*) discharges into the stomach lumen from the posterior side, and the right (Fig. 8, *f*) and the left (Fig. 8, *i*) ones from their respective side.

The wall of the liver is thrown into folds in order to increase the secretory surface. Almost all the liver cells are vvey active in secreting digestive ferments (cellules à ferments: Hecht, 1896), because they are packed with large, green or brown granules. The colour of the liver varies with the granules contained. When green granules predominate over brown ones the liver looks green, and conversely an abundance of brown granules results in a brown liver. In sections the granules contained stain red with eosin, and almost entirely obscure the details of the cell. Each liver cell is tall and columnar and carries a basal nucleus, rich in chromatin and embedded in cytoplasm. From the free surface of the cell are given off fine cilia-like filaments which are clearly visible in fresh material. Henneguy (1925) describes similar filaments in certain Aeolids and *Elysia*, where each filament is said to

lie upon a basal granule.

The older cells of the liver (cellules vacuolaires excrétrices; Hecht, 1896) become round or oval, and are sharply distinguished from active ones (Fig. 13, *a*), and eventually they are removed from among the latter and are shed into the lumen of the liver (Fig. 13, *b*). They can be seen finally in process

Fig. 13. Sections of liver, showing older liver cells in process of being shed into hepatic lumen (×300).

of being conveyed to the exterior through the stomach and intestine. In this way the liver seems to have an excretory function in addition to its secretory one. Each older cell, fixed with osmic acid, is seen to be filled with small refractive granules, which tend · to be vacated in sections of Bouin fixation. It is almost free from secretory granules, and the nucleus, which has a clear nucleolus but lacks chromatin, is shifted near the centre of the cell.

In the main the structure of the liver epithelium in the present species is less complicated than that described by Hecht (1896) for certain Aeolids and by Agersborg (1923) for *Melibe*.

6. Intestine: The pyloric end of the stomach continues into the first part of the intestine only gradually narrowing and by the folding of the canal. Here the lining epithelium differs hardly at all in structure from the stomach epithelium, that is, it is glandular and carries cuticle and cilia. As the intestine passes forward, it becomes small, smooth-walled and less glandular, and loses cuticle. The cilia are particularly long and help the forward movement of undigested fragments. The intestine (Fig. 1, *l*; Fig. 8, *j*) then describes a broad loop in front of the accessory renal gland and continues into the rectum, though this part is not clearly marked off from the rest of the intestine. The rectum (Fig. 8, *c*) passes upward to terminate in an anus (Fig. 1, *e*; Fig. 8, *d*) which opens always to the right of the mid-dorsal line.

7. Anal organ: The anal organ (Fig. 1, *f*; Fig. 8, *e*) is a large spherical sac whose low epithelial cells bulge inward because of an exceedingly large nucleus rich in chromatin. The contents of the organ are finely granular and tinged with a reddish brown. From the anal organ arises a slender duct

which joins the rectum at a point some distance below the anal opening. In structure it does not differ from the rectum, except that the former has a muscular coat. The anal glands described by Trinchese (1881), Pelseneer (1894) and Henneguy (1925) in *Janus,* and by Hecht (1896) in *Proctonotus,* differ structurally from the anal organ here dealt with.

6.   Nervous System and Sense Organs

The central nervous system (Fig. 1, *b*; Fig. 14) is of great interest because it is well developed in contrast with the somewhat unusual construction of other viscera. The cerebral, pleural and pedal ganglia form a nerve ring surrounding the oesophagus. The two cerebral and two pedal ganglia are connected by means of a cerebral and a pedal commissure respectively, the former dorsal and the latter ventral in position. The connectives link up the cerebral and pleural, cerebral and pedal, and pleural and pedal ganglia. The cerebral ganglia are connected with the ventrally placed buccal ganglia, which are united by a commissure.

With regard to the structure of the ganglions in general, it is noteworthy that the ganglion cells are furnished with nuclei much irregular in size and they are grouped near the surface to form a cortex. The bulk of the ganglion is made up of fibres running in various ways. The nerves are clothed with neurilemma. When living, each ganglion is loaded with a large number of fine orange granules.

1.   Cerebral ganglia: The cerebral ganglia (Fig. 14, *a*) are the main sensory centres supplying nerves to the rhinophores, rudimentary oral tentacles, eyes, otocysts and other organs. They lie on the dorsal side of the oesophagus at its point of origin from the pharyngeal bulb. The two cerebral ganglia are connected by a short but stout cerebral commissure. Below the oesophagus they are united by a delicate paracerebral commissure (Fig. 14, *i*), arising from the posterior end of each ganglion, close to the origin of the cerebro-pedal connective, and looping ventrally below the oesophagus in front of the pedal commissure.

The rhinophorial nerve (Fig. 14, *b*) is the largest of all the cerebral nerves. It leaves the anterior end of the cerebral ganglion and runs forward into the rhinophore. It forms a bulbous ganglion (basal-rhinophorial ganglion) where it leaves the cerebral ganglion and terminates distally in a well-marked ganglion (distal-rhinophorial ganglion) at the bottom of the rhinophore. The latter ganglion gives rise to many nerves which, before supplying the rhinophorial epithelium, develop a subepithelial ganglion layer (See also Rhinophore).

The second largest is the oral nerve (Fig. 14, *d*). This· arises from the antero-lateral side of the cerebral ganglion, passes forward and continues into a well-marked distal ganglion from which gangliate nerves are especially supplied to the rudimentary oral tentacle on each side of the mouth.

The optic nerve is represented by an ovate optic ganglion lying on the postero-lateral corner of the cerebral ganglion. The auditory nerve is a short
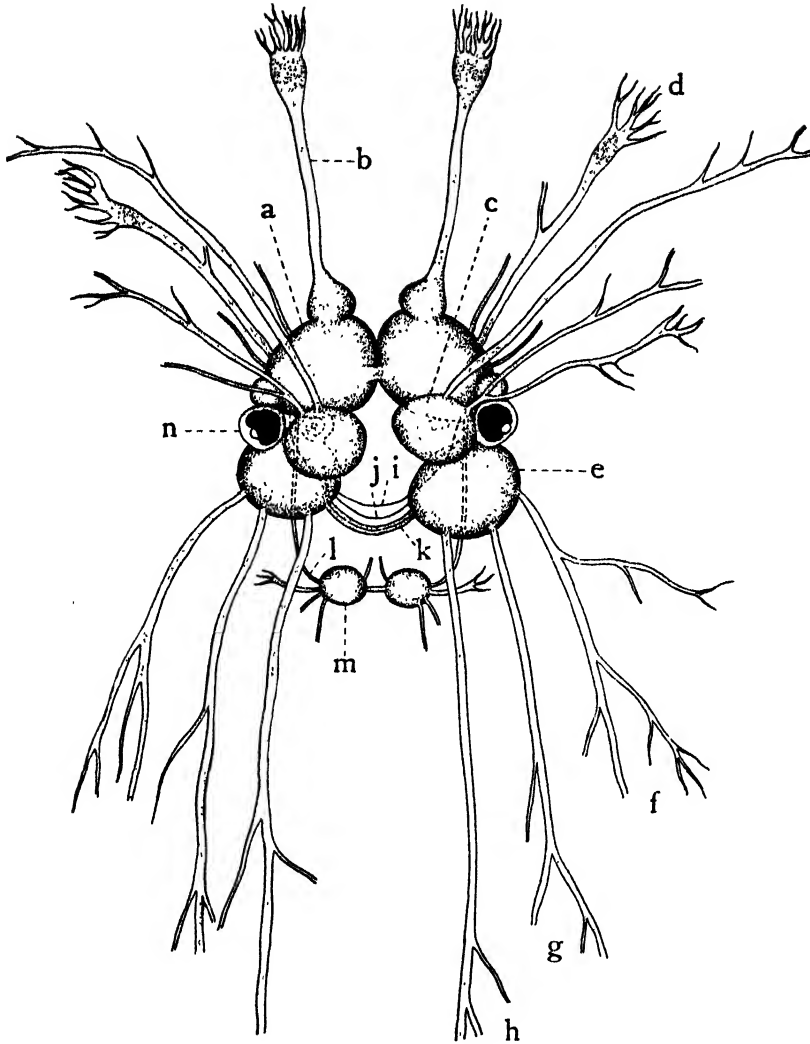
Fig. 14.   General dissection of nervous system, from dorsal side (×115).   *a.* cerebral
ganglion, *b.* rhinophorial nerve, *c.* pleural ganglion, *d.* oral nerve, *e.* pedal gan-
glion, *f-h.* pedal nerves, *i.* paracerebral commissure, *j.* parapedal commissure, *k.*
pedal commissure, *l.* cerebro-buccal connective, *m.* buccal ganglion, *n.* eye.

nerve which arises from the postero-ventral side of the cerebral ganglion, close
to the origin of the cerebral commissure, and passes downward to a small
auditory ganglion, on which the otocyst rests.   Besides the above mentioned
nerves, the cerebral ganglion sends out two nerves whose distribution could
not be traced.

    2.   **Pleural ganglia**:   The pleural ganglia (Fig. 14, *c*), lying between and
above the cerebral and pedal ganglia, are clearly distinguished from the cere-

bral ganglia. From each pleural ganglion are given off two nerves whose distribution could not be traced.

3. Pedal ganglia: The pedal ganglia (Fig. 14, *e*) are situated posterior to the cerebral ganglia and ventral to the pleural ganglia. They are connected by two commissures, pedal and parapedal. The pedal one (Fig. 14, *k*) is a large commissure which loops ventrally below the oesophagus and completes the cerebro-pedal nerve ring. The delicate parapedal one (Fig. 14, *j*) runs along the preceding commissure. Three pairs of nerves arise from the pedal ganglia: the anterior pedal nerve passes forward to the anterior region of the foot, while the middle and the posterior pedal ones supply to the middle and the posterior regions of the foot. The pedal ganglia are thus the motor centres regulating movements of the foot.

4. Buccal ganglia: The buccal ganglia (Fig. 14, *m*) are small, lying on the postero-dorsal side of the pharyngeal bulb. They are slightly anterior to the cerebral ganglia with which they are connected by cerebro-buccal connectives. The buccal commissure is short. The buccal ganglia are the seat of the sympathetic system and supply nerves to the wall of the pharyngeal bulb.

Sense Organs

Sense organs consist of paired eyes and paired otocysts. In addition, there are scattered sensory cells on the general integument, in particular on the rhinophores und rudimentary oral tentacles.

1. Eye: The eyes are a pair of visual organs visible through the transparent integument. They rest upon the optic ganglia, and the optic nerves are so short that their position varies with the motion of the central nervous system. Each optic nerve enters the eye at the side facing the cerebral ganglion. The structure of the eye is primitive, as in *Acella, Pleurobranchaea* and *Duvaucelia* (Pelseneer, 1894). Each eye (Fig. 15) is a closed vesicle deeply sunk below the integument, and the epithelium overlying it does not form a cornea. The cells which make up the wall of the optic vesicle are not of equal height. Towards the summit of the vesicle they are flattened, non-pigmented and free from nuclei, and form the so-called false cornea. Laterally and basally they are of much greater vertical diameter, increasing in height from the false cornea to the bottom of the vesicle, where they form a retina. They include each a large spherical nucleus in which may be seen a nucleolus and numerous chromatin granules. There is abundant black pigment in the retina abutting on the interior lumen of the vesicle, and in median vertical sections the pigment zone forms a rather broad horseshoe, whose ends reach the false cornea. The pigment is in the form of minute ·granules closely crowded together. The retinal cells are all of one kind, not differentiated into two categories, retinophora and retinulae as in *Tethys* (Eales, 1921). A delicate protoplasmic layer (bâtonnets; Pelseneer, 1894) is formed from the retinal cells and abuts on the lumen of the vesicle. Probably all the retinal cells are sensitive to light. The well-defined lens is not strictly spherical in
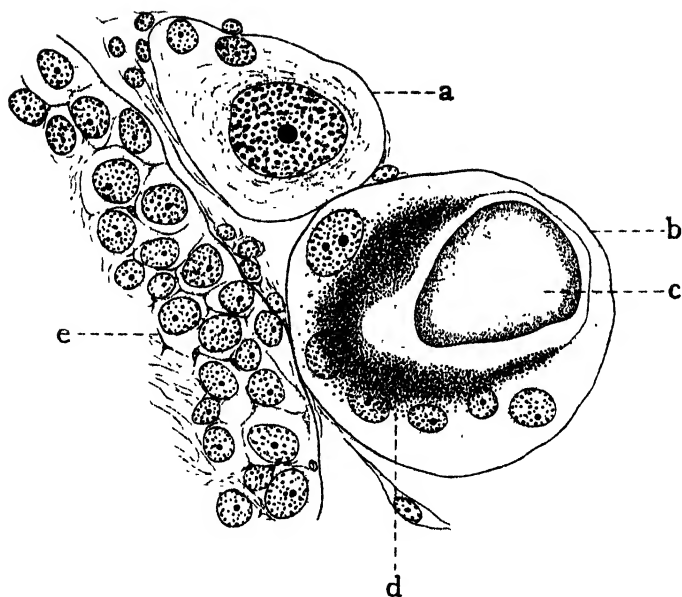
Fig. 15. Median vertical section of the eye (×800). *a.* optic ganglion, *b.* false cornea, *c.* lens, *d.* retina, *e.* cerebral ganglion.

contour but is biconvex; the dome-shaped surface towards the retina is very much more convex than the pseudocorneal surface. The lens appears to be a hyaline cuticular formation which takes eosin in sections.

2. Otocyst: The otocysts (statocysts) lie on the postero-ventral sides of the cerebral ganglia, ventral to the pleural ganglia and dorsal to the pedal ganglia. Each otocyst, resting upon the end of the auditory nerve, is held in place by fibrous bands which fasten it to the pleural and the pedal ganglia. It is a spherical sac containing a colourless fluid in which floats a large spherical otolith. The latter appears to have a centrum surrounded by fine radiations. When living, the otolith in the present species is kept in constant motion by short cilia borne on the free surface of the low otocyst epithelium, though Eales (1921) reported that in *Tethys* the otocyst epithelium is free from cilia.

7. Circulatory System

The circulatory system consists of a two-chambered heart, a haemocoele and abundant lacunae. The heart (Fig. 1, *n*; Figs. 16 and 17) is exposed in the haemocoele, not enclosed within a pericardium. It is situated in the middle line, just anterior to the accessory renal gland and the kidney, overlying the intestinal loop. The heart beats can be watched through the transparent integument. The pulsation varies in individuals from 27 to 54 per minute.

The heart consists of two chambers, an anterior and a posterior. It is

not easy to determine morphologically which is the ventricle and which the auricle, because the heart is not connected with any blood vessel. The anterior chamber (Fig. 16, *a* ; Fig. 17, *c*) is a thin walled roomy sac, capable of considerable extension. It is completely blind in front and no blood-vessel
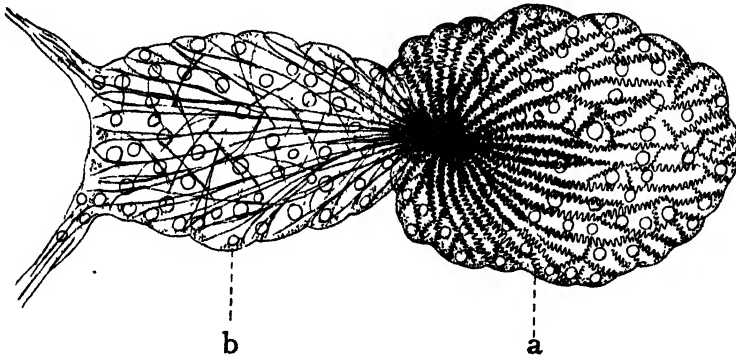
Fig. 16. Right lateral view of fresh heart (×170). *a.* anterior chamber, *b.* posterior chamber.

leaving it is visible anywhere. The wall is diaphanous with a very fine interlacing network of elastic muscle fibres. Each fibre is slender and carries a nucleus at the base or midway of its length. When contracted it takes the form of a constricted rubber-strand. On each postero-lateral wall of the
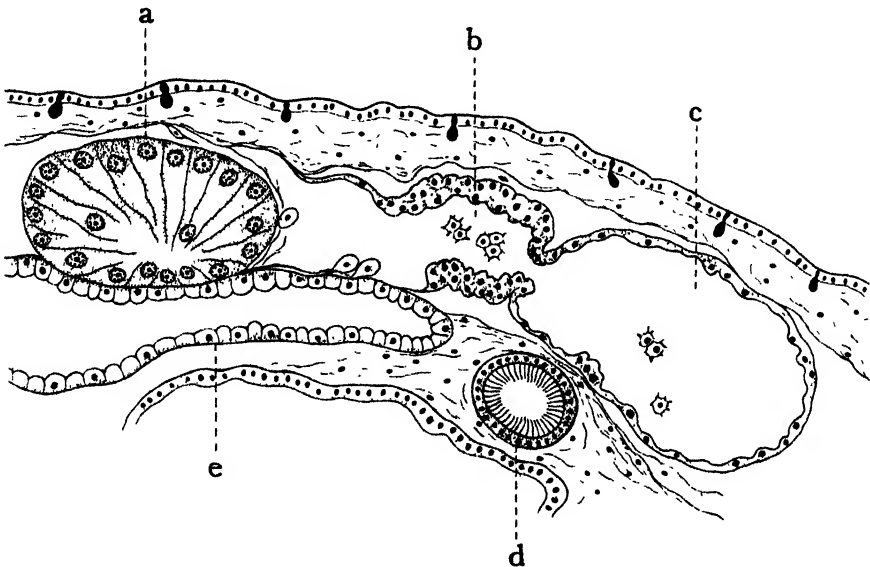
Fig. 17. Median longitudinal section of body, showing heart and other viscera (×170). *a.* accessory renal gland, *b.* posterior chamber of heart, *c.* anterior chamber of heart, *d.* intestine, *e.* kidney.

anterior chamber there is a centre from which the elastic muscle fibres (group A) radiate distributing themselves over the whole lateral surface of the organ. A part of the fibres (group B) supplies the lateral wall of the posterior chamber. The heart beats in the following manner: as group A contracts the anterior chamber diminishes in size, and at the same time group B relaxes enlarging the posterior chamber; the extension of the anterior chamber and the contraction of the posterior are caused by the reverse action of the groups, A and B.

The posterior chamber (Fig. 16, *b*; Fig. 17, *b*) is either the same size as, or smaller than, the anterior chamber from which it is marked off by a constriction. In structure it does not differ much from the anterior chamber, except that it has a large posterior aperture. The posterior end of the heart is held in place by means of an upper and a lower fibrous bundle, attached to the upper body wall and the kidney respectively.

The heart has no endothelial lining, so that the muscle fibres are bathed directly in the blood. Morphologically it is regarded here as representing a true heart, but it has some unusual characteristics, namely: (1) the complete degeneration of a pericardium and (2) of blood-vessels, (3) the presence of a large posterior aperture through which the lumen of the heart communicates with the haemocoele. It is not clear just what the function of the heart thus peculiarly constructed may be. In my opinion the heart beats serve for maintaining a constant current of blood in the haemocoele.
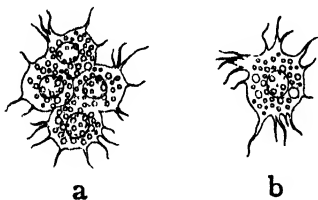
Fig. 18. Living amoebocytes (×650). *a.* clump of amoebocytes, *b.* amoebocyte with pseudopodia.

The blood is colourless and contains amoebocytes (haemocytes). Each amoebocyte (Fig. 18, *b*) is an amoeboid corpuscle provided with fine bristle-like pseudopodia, often branched, by means of which it is able to move. Sometimes the corpuscles aggregates, becoming entangled by the pseudopodia, and in this way clumps are formed (Fig. 18, *a*). The fresh amoebocyte with a spherical nucleus is almost colourless and transparent and contains granular inclusions. It measures from 10 to 13 μ across.

8. Respiratory System

As special respiratory organs such as gills are entirely wanting in the present species, it is probable that the mantle, as is generally believed in other Nudibranchs, plays the most important rôle in the respiration of the animal. The blood traverses the lacunae in the integumental connective tissue, and in this way metabolism may take place between the blood and the sea-water surrounding the animal. The oxygenated blood travels back to the haemocoele, where the venous blood is mixed with the one from the integument.

9. Excretory system

The excretory system consists of a single kidney, a ureter, a reno-coelomic canal and an accessory renal gland.

1. Kidney: The kidney or renal sac (Fig. 1, *k*) is a simple longish tubular sac without lateral diverticula, and presents nothing like the complexity of outline observable in most Opisthobranchs. It is blind both in front and behind, and extends over the viscera, immediately below the integument. In my previous paper (Baba, 1931) the anterior portion of the kidney is erroneously described as to form two pulsatory chambers (renal heart), continuous behind with the body of the kidney. By closer examination, both by dissection of living animals and by observation of serial sections, it is revealed that the pulsatory function is carried on by an independent heart, as is usual in other Opisthobranchs (See also Circulatory System). Consequently the ureter and reno-coelomic canal must be recognized as arising from the kidney.

The kidney (Fig. 17, *e*) is a coelomic sac lined everywhere with low cuboidal cells, with basal nuclei and vacuolate cytoplasm. Granular concretions are preserved in the renal cells fixed with Champy's fluid. The kidney is held in place, fastened by enveloping connective tissue to the body wall and various viscera.

2. Ureter: The ureter leaves the dorso-lateral wall of the kidney at a certain distance from its anterior end, and debouches to the exterior by a small nephroproct which lies close to the left of the anus. Its wall consists of a ciliated epithelium resting upon a basement membrane.

3. Accessory renal gland: The accessory renal gland (Fig. 1, *m*; Fig. 17, *a*) lies immediately on the left side of the ureter, and empties its secretion through an internally ciliated canal leading into the middle of the ureter. The microscopical structure of this gland is as described previously (Baba, 1931). Each fresh isolated gland cell (Fig. 19) is flask-shaped, the neck of the flask forming an exceedingly elongated duct for the discharge of secretion from the bulbous portion. The granular secretion takes Delafield's haemotoxylin, but shows no affinity for special mucus stains. The whole outer surface of the accessory renal gland has a thin layer of connective tissue.

The present accessory renal gland appears to be allied to the renal orifice glands (glandes de l'orifice rénal) described by Hecht (1896) for *Calma*, in which, though the structure is far less complicated, the unicellular pyriform glands are disposed round the nephroproct, making their way through the integumental epithelium.

4. Reno-coelomic canal: The reno-coelomic canal emerges from the right lateral wall of the kidney a
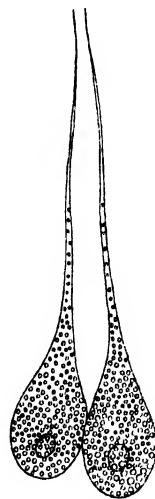
Fig. 19. Fresh isolated cells of accessory renal gland (×650).

little distance in front of the origin of the ureter, and leads latero-ventrally (see also Baba, 1931). It is a barrel-shaped organ, about thrice as long as broad, and is lined with a low epithelium which bears long cilia. These cilia appear to be matted together into a single tuft from each cell, and bend in the lumen towards the renal end of the canal, as has already been described by Hecht (1896), MacFarland (1923) and Agersborg (1923) for various Nudi-branchs. Blood from the haemocoele may enter the kidney by means of the reno-coelomic canal, and the renal excretion is discharged through the ureter.

5. Excretory organs in general: The kidney is not the only organ of excretion. The older cells of the liver and the plasma cells of connective tissue are all concerned with the elimination of waste matter (see also Liver and Mantle).

10. Reproductive System

The reproductive system consists of testes, ovaries, hermaphrodite duct, male duct, female duct and vagina, all of which are covered with a thin layer of connective tissue.

A. Male Part

1. Testis and spermatogenesis: The mature testis (Fig. 1, *j*; Fig. 20, *i*; Fig. 21) is a spherical sac with a more or less large lumen. The wall is made up of spermatocytes which proliferate to form abundant spermatids and spermatozoa in various stages of development, and a series of spermatogenesis may thus be observed, but the bodies formed are not of such a size as to allow an easy cytological study.

The primary spermatocyte (Fig. 22, *a*) in the resting stage has an exceedingly large nucleus, rich in chromatin granules attached to a linin-network. It gives rise to the secondary spermatocytes (Fig. 22, *e*) which are smaller than the mother cell. The spermatid (Fig. 22, *i*) is a product of division of the secondary spermatocyte. It is very small and contains a nucleus which gradually elongates itself to form the head of the spermatozoon.

The complete spermatozoon (Fig. 23, *f*) is of usual elongated type with a fusiform head, a little rounded posteriorly, and a long vibratile tail. The tail of the fresh spermatozoon consists of an axial filament and a vibratile membrane which keeps the spermatozoon in constant motion. The head of the younger spermatozoon (Fig. 23, *c-e*) may bear a clear vesicle of protoplasm, or this may be distributed in the form of droplets along the course of the tail.

As spermatogenesis proceeds, the wall of the testis becomes thinner and the spermatozoa, fastened together by their heads, come in close contact with the testis epithelium. This epithelium carries large nuclei and supplies nourishment to the heads of the spermatozoa as long as they stay in the testis lumen.

2. Hermaphrodite duct: From the testes arise two small ducts which
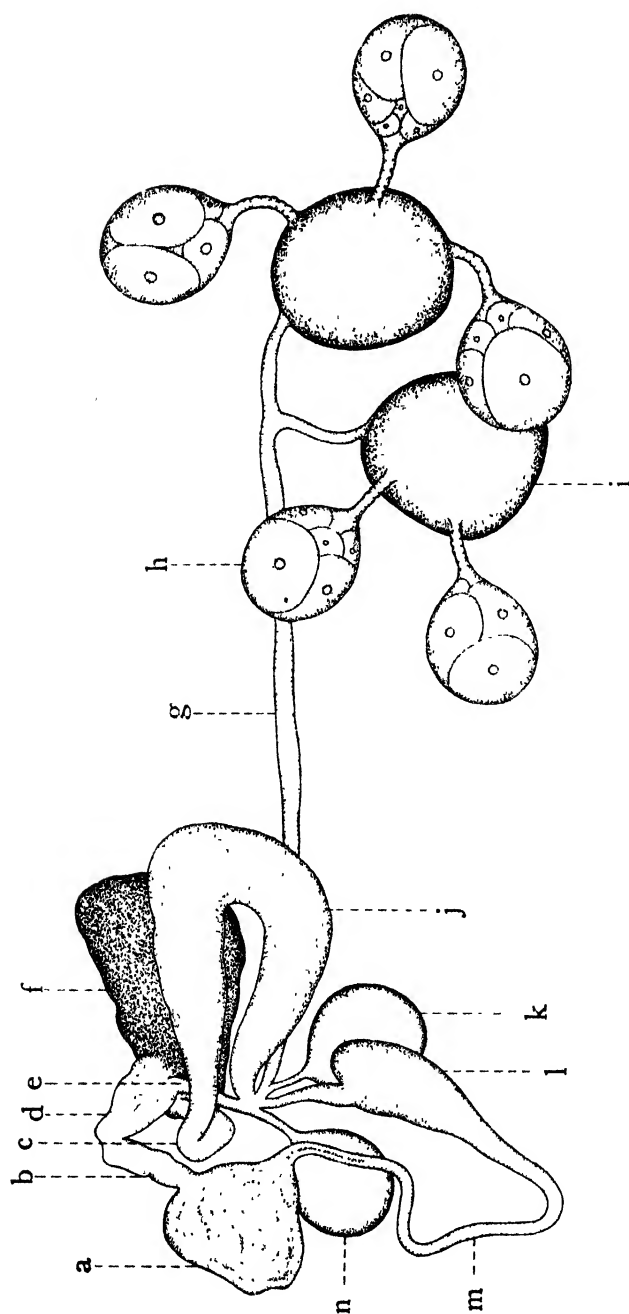
Fig. 20 General dissection of reproductive system, from dorsal side (×60). *a.* penis sac, *b.* male vestibulum, *c.* albumino-mucous communication, *d.* oviduct, *e.* vagina, *f.* mucous gland, *g.* hermaphrodite duct, *h.* ovary, *i.* testis, *j.* albumen gland, *k.* spermatocyst, *l.* prostata, *m.* vas deferens, *n.* spermatheca.

Fig. 21. Section of testis to show testis cells in various stages of spermatogenesis (×100).

soon unite to form a slender common genital duct or hermaphrodite duct (Fig. 20, *g*). This duct passes forward to the level of the genital complex where it receives the duct of the spermatocyst, and then bifurcates into a male and a female duct. The wall of the hermaphrodite duct consists of a low columnar epithelium with vibratile cilia.

3. Spermatocyst: The spermatocyst or vesicula seminalis (Fig. 20, *k*) is a spherical sac connected by a small stalk to the anterior end of the hermaphrodite duct. In the mature animal, it is crowded with irregularly arranged spermatozoa, thus acting as a reservoir for spermatozoa coming from the testes. The lining epithelium is very low and is devoid of cilia except near the origin of the stalk, where it is ciliated.

4. Prostata: The male duct which conveys spermatozoa to the exterior arises from the

Fig. 22. Stages of spermatogenesis (×1700). *a-d.* primary spermatocytes. *a.* resting phase, *b.* prophase, *c.* metaphase, *d.* anaphase. *e-h.* secondary spermatocytes. *e.* resting phase, *f-g.* prophase, *h.* anaphase, *i-k.* spermatids.

anterior end of the hermaphrodite duct, and leads, in a large loop, into the penis sac which opens to the male orifice through a short canal (male vestibulum). It is differentiated into two parts, prostata and vas deferens. The prostata (Fig. 20, *l*) is opaque when alive and is lined with two sorts of cells: (1) The gland cells (Fig. 24, *d*) are tall, columnar and non-ciliated, and have basal nuclei surrounded by cytoplasm. The upper half of the cell is filled with small granules which are colourless when fresh and take eosin in sections.

In copulation the gland cells secrete a copious supply of serum which helps the spermatozoa in their progressive motion. The discharged gland cells (Fig. 24, *b*)

Fig. 24. Prostate epithelium fixed in osmic acid (×800) *a.* ciliated interstitial cell, *b.* discharged gland cell, *c.* connective tissue, *d.* gland cell with secretion.

become vacuolate and foamy in appearance. (2) The ciliated interstitial cells (Fig. 24, *a*) are decidedly small

Fig. 23. Fresh spermatozoa in various stages of development (×800). *a-e.* young spermatozoa, *f.* mature spermatozoon.

and triangular, and are wedged among the superficial parts of the gland cells. Pohl (1905) describes for *Polycera* a similar structure of the prostata.

5. Vas deferens : The wall of the vas deferens (Fig. 20, *m*) is made up of three layers : (1) The innermost layer is a low ciliated epithelium

Fig. 25. Section of vas deferens to show structure of wall (×1200). *a.* ciliated epithelium, *b.* fibrous layer, *c.* muscular layer.

(Fig 25, *a*). (2) The middle layer is loose and has fibrous connective tissue cells (Fig. 25, *b*). (3) The outermost layer consists of spindle-shaped muscle cells gathered up to form a thick muscular wall (Fig. 25, *c*). This layer controls the expansion and contraction of the vas deferens. Bipolar connective tissue cells are especially abundant on the outer surface of the vas deferens. The distal portion of the vas deferens does not form any special copulatory organ, but is armed internally with spines (Baba, 1931), which are formed by cuticular secretion from the lining epithelium.

6. Penis sac: The vas deferens plunges into the left side wall of the penis sac, and the point of entrance is guarded by two large valve-like outgrowths, the ciliated epithelium of which being thrown into corrugations. The penis sac (Fig. 20, *a*) is an exceedingly large roomy sac overlying the pharyngeal bulb. It is lined everywhere with a low ciliated epithelium. The penis sac continues into a thin-walled male vestibulum which opens into a male orifice.
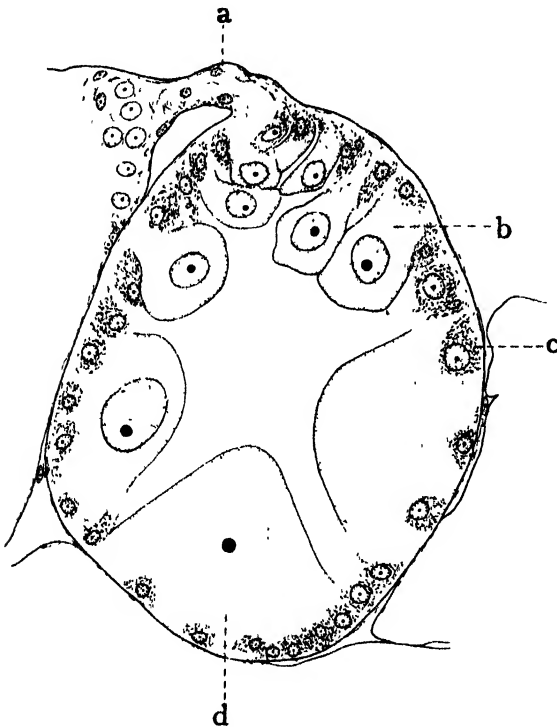
Fig. 26. Section of full-grown ovary (×200). *a.* ovarian stalk; *b.* young oocyte; *c.* ovarian epithelium; *d.* mature oocyte.

B.   Female Part

1. Ovary and oogenesis: The full-grown ovary (Fig. 1, *g*; Fig. 20, *h*; Fig. 26) is nearly oval in shape with a slender stalk attached to the testis, and is bounded by epithelial cells interspersed among which are oocytes in various stages of development. The epithelial cells among the youngest oocytes are tall and columnar, with nuclei located midway between the base and the free end. As the oocytes gradually enlarge, they come to cover several epithelial cells, and finally the boundary between the cells of the two sorts becomes obscure. When the oocytes mature sufficiently, the epithelial cells become low and more or less depressed. Each epithelial cell carries a distinct nucleus rich in chromatin granules, and closely-set fibrillar contents. The epithelial cells thus formed appear to serve as nurse cells (see Okada, 1935) which supply the oocytes with nourishment during their growth.

The youngest oocytes (Fig. 26, *b*) lie near the proximal portion of the ovary, where the ovarian stalk (Fig. 26, *a*) originates. When fresh each oocyte is filled with pale or yellowish brown granules; the nucleus is distinct, spherical, and with a nucleolus and a small quantity of chromatin granules attached to a linin-network.

As the oocytes grow larger, they gradually bulge out towards the distal portion of the ovarian lumen. In the last stage of growth, the oocytes (Fig. 26, *d*) fill the greater part of the ovarian lumen and assume polygonal forms by mutual oppression. In the body of each mature oocyte there occurs an immense increase of orange-yellow yolk granules obscuring the outline of the nucleus. The free surface of the oocyte is defined by a delicate vitelline membrane.

During oviposition, the oocytes thus prepared are liberated from the ovarian wall and become the primary oocytes. They travel through the testis and hermaphrodite duct, meet with spermatozoa from the spermatheca, receive albumen capsules and a mucous band while visiting the albumen and the mucous glands, and finally leave the female orifice. The earliest stage of the free primary oocytes which I have seen was taken from the mucous gland while the egg-band was being formed. The form of each oocyte at such a stage is not yet strictly spherical. The outline of the nucleus is obscure, though it is obvious that the same is shifted near the animal pole of the cell. The nucleolus is accompanied by astral rays radiating from a centrosome. The chromatin granules hitherto latent now appear as a few small rod-like bodies scattered near the nucleolus.

2. Albumen gland: The female duct through which the primary oocytes are conveyed arises from the anterior end of the hermaphrodite duct, close to the origin óf the male duct. It is differentiated into three successive parts, namely (1) a large curved albumen gland, (2) a large massive mucous gland and (3) a short oviduct (female vestibulum).

The structure of the albumen gland (Fig. 20, *j*) is as described previously (Baba, 1931). The gland cells are of tall columnar form, with basal nuclei rich in chromatin and surrounded by cytoplasm, and with large transparent spherules which stain vivid red with eosin. Occasionally there are a few orange granules in the gland cell. The infundibuliform cavities described by Henneguy (1925) for *Janus*, *Calma* and *Duvaucelia*, do not occur at the free end of the gland cell. Small ciliated interstitial cells lie as usual among the superficial parts of the glandular epithelium. The terminal portion of the albumen gland is narrowed and thin-walled, and continues into the mucous gland. The structure of this portion is as described previously (Baba, 1931). The albumen gland provides to each primary oocyte a clear capsule which takes eosin in sections.

3. Mucous gland: The mucous gland (Fig. 20, *f*) has a large lumen. Its wall consists of gland cells and ciliated interstitial cells. Each gland cell with a basal nucleus is tall and columnar, and is filled with fine colourless granules which stain metachromatically with specific mucus stains. It includes abundant

orange granules, and as a whole the mucous gland appears slightly brownish. It is here that a group of the primary oocytes is united into a continuous egg-band by clear mucus secretion from the glandular epithelium.

4. Oviduct: The oviduct epithelium is thin and ciliated and is thrown into corrugations which allow of great expansion. During oviposition the oviduct is everted through the female orifice (see also Oviposition).

C. Vaginal Part

1. Vagina: The vagina (Fig. 20, *e*) arises from the ceiling of the oviduct at its origin from the mucous gland. It leads into the anterior end of the hermaphrodite duct, close to the bifurcation of the latter into a male and a female duct, and joins with the stalk of the spermatheca. It is a short, small duct lined with a ciliated epithelium. It does not act as a vagina in the strict meaning of the term, because it never receives the vas deferens in copulation (see also Copulation).

2. Spermatheca: The spermatheca or receptaculum seminis (Fig. 20, *n*) is a roomy spherical sac which is as large as, or larger than, the spermatocyst. The lining epithelium is even and non-ciliated; the cytoplasm is finely granular and the nuclei are distinct. In sections groups of spermatozoa are always visible penetrating into the epithelium, with the heads gathered together. It is probable that the epithelium provides nourishment to the introduced spermatozoa in order to keep them alive for fertilization. The spermatheca is distinguished from the spermatocyst by the thicker epithelium providing nourishment for the spermatozoa and by the active spermatozoa which it contains. The stalk of the spermatheca is ciliated all over its inner surface.

The present spermatheca is structurally less complicated than the ovispermatheca in *Melibe* (Agersborg, 1923), where the internal lumen is said to be filled with spermatozoa and eggs. As already stated above, the spermatocyst acts as a reservoir for the spermatozoa from the testes and the spermatheca for introduced spermatozoa, as in *Madrella* (Odhner, 1917). In *Tethys* (Eales, 1921), *Caliphylla* (Brüel, 1904), *Drepania* (MacFarland, 1929), *Glossodoris* and other Dorids (Odhner, 1926; 1934), both the spermatheca and spermatocyst are known to be accessory to the vaginal tract.

IV. Embryology

From the embryological point of view the present species, together with *Acteonia cocksii* (Alder & Hancock), *Runcina coronata* (Quatrefages) and *Vayssierea caledonica* Risbec, is distinguished from the rest of the Opisthobranchs by the shortening of its early life history (condensation embryogénique of Pelseneer, 1899, 1911; développement direct of Risbec, 1928). Here the veliger, with a rudimentary velum and without an operculum and a nautiloid shell, transforms directly into the larval form similar to the adult while still

within the egg-capsule.

1. Embryonal Development in Egg-capsule

The material to which the following observation refers was collected in February, 1934 and October-November, 1935, and reared in glass-vessels full of sea-water (about 8–10°C). The time required for the developmental changes after oviposition was approximately as follows:

Appearance of three polar bodies ....6–7 hours
2-cell stage ....12 „
4-cell stage...15–16 „
8-cell stage...17–18 „
16-cell stage ....28–30 „
32–64 cell stage...38–40 „
Blastula ....3–4 days
Gastrula with a large blastopore ....5–6 „
1st stage of veliger (veliger with a large blastopore and rudiments of dorsal
    humps)..6–7 „
2nd stage of veliger (veliger with a small stomodeal invagination, a velum,
    anterior dorsal hump a foot and two posterior dorsal humps)......8–9 „
3rd stage of veliger (veliger with a liver and an anal organ) ....11 „
Larva with rhinophores, eyes, otocysts and pharyngeal bulb, and ready to
    hatch ....13–14 „
Hatching...18–19 „

Each primary oocyte (Fig. 27, 1), immediately after oviposition, is spherical and uniformly yolk-laden, and measures about 230 μ in diameter. It is of a vivid orange-yellow colour. A few (4–6) hours later, the first polar body is given off. The second polar body arises from the same place as the first, pushing the latter outward. And finally the first polar body may divide into two smaller globules. It takes about an hour for the appearance of these three polar bodies. The egg-cell thus prepared is now called the ovum or egg (Fig. 27, 2).

The egg divides into two and then into four equal cells (Fig. 27, 3–4). In the 8-cell stage (Fig. 27, 5) the 4 upper cells (micromeres) are decidedly smaller than the lower sisters (macromeres). The subsequent proliferation of these cells results in the formation of a blastula (Fig. 27, 7) which, in dorsal view, is round or roughly quadrate in outline. Then there arises a large blastopore at the vegetal pole so that the blastula changes into a cap-like gastrula (Fig. 27, 8). After a while the gastrula passes into the first and then the second veliger-stage (Fig. 27, 9–10), and synchronously with this change the blastopore continues to decrease in size till at last it is completely replaced by a small invagination, the stomodaeum. The veliger with a stomodeal invagination in front, is a little longer than broad; the dorsum is characteristically marked by two humps, an anterior and a posterior. Cilia are especially borne on the front of the anterior hump, so that, though not bilobed as in other Opisthobranch veligers, the anterior hump may be regarded as representing a velum. *Acteonia* differs from *Okadaia* in having a ciliary band
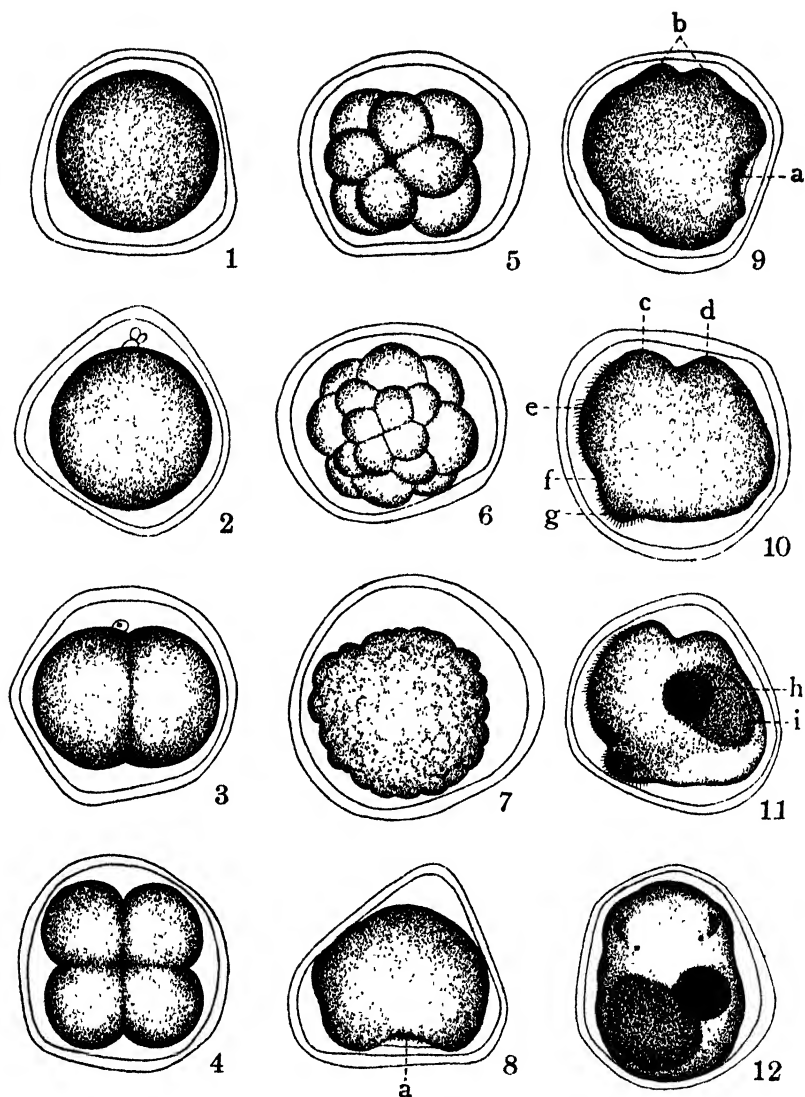
Fig. 27. Embryonal development in egg-capsule (×130). 1. Primary oocyte immediately after oviposition; 2. egg with 3 polar bodies at the animal pole; 3. 2-cell stage; 4. 4-cell stage; 5. 8-cell stage, animal pole view; 6. 16-cell stage; 7. blastula; 8. gastrula with a large blastopore at the vegetal pole, lateral view; 9. 1st stage of veliger; 10. 2nd stage of veliger, lateral view; 11. 3rd stage of veliger; 12. larva ready to hatch, dorsal view. *a.* blastopore, *b.* dorsal humps, *c.* anterior dorsal hump, *d.* posterior dorsal hump, *e.* ciliated velum, *f.* stomodeal invagination, *g.* foot, *h.* anal organ, *i.* liver.

on the velum, and *Vayssierea* in having two symmetrical humps (tubercules symétriques opposés) representing a rudimentary velum. ·The posterior hump

is as large as the anterior, without cilia and is divided by a mid-dorsal depression into two symmetrical humps. The foot is represented by a small ciliated prominence immediately below the tiny, slit-like stomodeal invagination. The veliger keeps whirling round in the egg-capsule by the aid of cilia borne on the velum and foot. The shell-gland never develops.

In the last stage of the veliger (Fig. 27, 11) there arise a reddish spherical anal organ and a larger, oval, brown liver; the foot is more pronounced; the postero-ventral area immediately below the liver becomes somewhat transparent. The veliger differs from that in most Opisthobranchs in the following respects: (1) the external form with dorsal humps, (2) the rudimentary velum without a trace of bilobation, (3) the absence of shell-gland and nautiloid shell, and (4) the foot which is small, with no operculum.

The veliger then undergoes metamorphosis and becomes a larva ready to hatch (Fig. 27, 12). At this stage the larva is like the adult in form, with the following well-marked organs: (1) a pair of rhinophores; (2) a pharyngeal bulb loaded with a radula; (3) a central nervous system accompanied by paired eyes and paired otocysts; and (4) a saccular liver containing ferment granules which are generally yellowish brown, rarely greenish.

For a *Vayssierea* larva about to hatch (29th day after oviposition) Risbec states that there are a well-developed female gland and two male glands, but such is not the case in the present larva as will be explained in the following section.

2. Morphology of the Young Specimen about 0.6 mm long

The material for the present study was obtained by breaking up old egg-capsules. When this is done young specimens, ready to hatch, creep out freely in the surrounding sea-water. These youngs may be regarded as not only of the last stage of embryonal development in egg-capsules but also in the commencement of the post-embryonal development in the open sea-water, before food is yet taken.

By this time each young animal has assumed the external form of the adult, though much smaller. The length of the body measures about 0.6 mm in creeping. The body is light yellow with a reddish anal organ in the middle of its length; a pair of black eyes are visible behind the rhinophores; the liver is slightly tinged with brown. The notable characteristics of the internal organization are: (1) the large pharyngeal bulb loaded with a well-defined central nervous system; (2) the short oesophagus continuous behind with the hepatic lumen, where the stomach wall is still undefined; (3) the liver which is simply saccular or shallowly bilobed in front; (4) the large anal organ; (5) the massive undifferentiated gonad without genital ducts. The accessory renal gland and genital orifices are wanting.

1. Mantle: The epithelial cells, both with and without cilia, are low columnar or almost cuboidal in form, and contain very large central nuclei showing division. The sensory and the mucous cells, together with pigment

cells containing light yellow granules, are differentiated from the epithelium. The cuticular covering is thin. Very large plasma cells with spherical inclusions are scattered in the subepithelial connective tissue.

2. Foot: The pedal epithelium is nearly the same as in the adult. The pedal glands are fairly well developed and ready for mucus secretion.

3. Digestive system: The pharyngeal bulb is well developed as in the adult and occupies the anterior one-third of the haemocoele. The radula consists of about 15 rows of teeth, 3 in each half-row. The oesophagus, the beginning of which is guarded by a pair of pharyngeal valves, is a short tube continuous behind with the hepatic lumen where the stomach with its own epithelium is not yet differentiated from the rest of the alimentary canal. The liver (Fig. 28, f) is a simple saccular organ which fills the posterior half of the haemocoele. Occasionally its anterior end is shallowly bilobed, and the wall is thrown into folds. The fresh epithelium is columnar with basal nuclei showing division, and contains colourless, greenish, or light brown ferment granules which stain red with eosin in sections. When exuded, these ferment
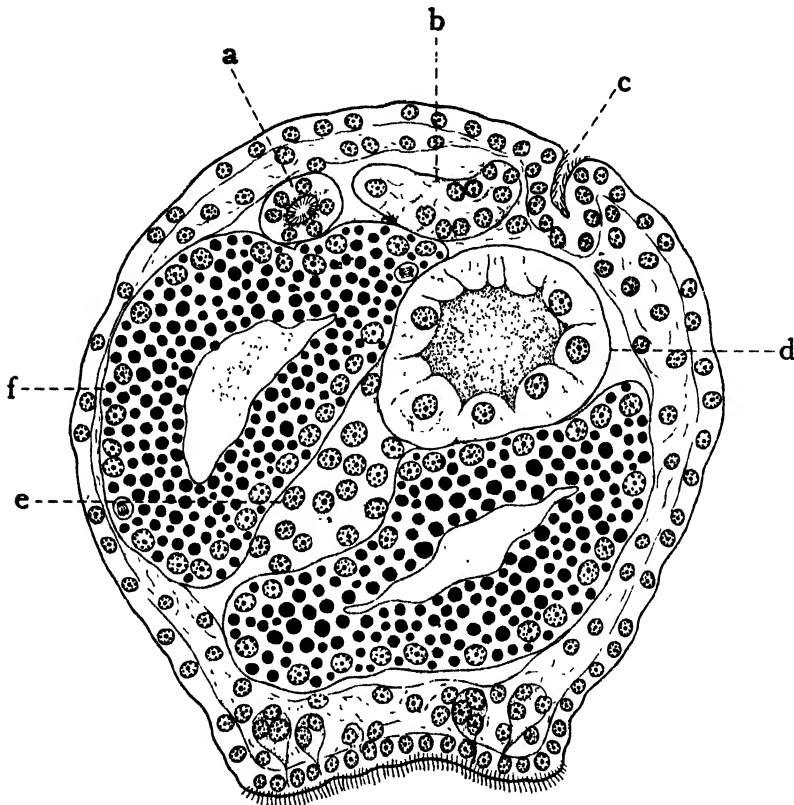
Fig. 28. Transverse section of a young specimen about 0.6 mm long (×700). *a.* intestine, *b.* kidney, *c.* anus, *d.* anal organ, *e.* gonad, *f.* liver.

granules fill the hepatic lumen as a digestive fluid. The epithelium never contains spherical excretory cells seen in the adult. From the dorso-lateral side of the liver, midway of its length, is given off an intestine (Fig. 28, a) which is at first large, gradually decreasing in calibre forward. It leads into the anus. Cilia are borne on the free surface of the intestinal epithelium. The position of the anus (Fig. 28, c) is as in the adult. The anal organ (Fig. 28, d) is the most noticeable because of its relatively large size (about 70 μ across) and its reddish colour. Unlike the adult, the lining epithelium is of low cuboidal form with central spherical nuclei and clear, almost vacuolate cytoplasm. The contents of the anal organ consist of reddish granules, possibly exuded from the above-mentioned epithelium. The anal organ opens to the exterior through an internally ciliated duct which leads to the end of the intestine.

4. Nervous system and sense organs: The central nervous system, together with eyes and otocysts, is already well developed as in the adult and occupies a large space between the pharynx and the liver.

5. Circulatory and excretory systems: The heart appears to be a small mass of cells. The kidney (Fig. 28, b) is a simple, longish organ overlying the liver between the origin of the intestine and the central nervous system. It is solid without a lumen and consists of vacuolate cells. The ureter is an integumental invagination which leads directly into the kidney. The accessory renal gland is not yet visible here. The reno-coelomic canal is the same as in the adult.

6. Reproductive system: The primitive gonad (Fig. 28, e) lies close to the front of the liver and is represented by a small mass of germ cells not differentiated into spermatogonia and oogonia. Each germ cell consists of a spherical nucleus and clear cytoplasm, and occasionally shows division. Both genital ducts and their orifices are wanting.

3. Morphology of the Young Specimen about 1 mm long

In order to pursue the further development of post-embryonal organs, young specimens, up to 1 mm in length, have been selected for study. At this stage the body is light yellow, and the anal organ and liver masses are striking. The appearance of the rudimentary accessory renal gland, the division of the liver into 3–4 lobes, and the separation of the gonad into two testes and an accessory genital mass (rudiment of genital ducts) are characteristic points in the young. The mantle, rhinophores, foot, central nervous system and sense organs are almost the same as in the adult. The mucous glands are seen to be active in providing secretion.

1. Digestive system: The radula contains about 25 rows of teeth. Both the oesophagus and intestine elongate to communicate with the posteriorly placed hepatic lumen. The liver increases considerably in size and the lining epithelium is thrown into folds in order to increase secretory surfaces. It is now divided into 3–4 lobes, each opening into a common hepatic lumen which

is not yet bounded by a stomach epithelium. Unlike in younger animals about 0.6 mm long, the ferment granules are mostly brown or green, rarely colourless. The epithelium of the anal organ now decreases in height, except at the place where large nuclei lie.

    2. Circulatory system: The pulsatory heart is now clearly visible overlying the anterior loop of the intestine, close to the free end of the reno-coelomic canal. The pericardium is wanting.

Fig. 29. Transverse section of young specimen about 1 mm long, passing through accessory renal gland (×1200). *a.* kidney wall, *b.* accessory renal gland, *c.* rectum.

    3. Excretory system: The kidney (Fig. 29, *a*) acquires a spacious lumen. The accessory renal gland (Fig. 29, *b*) now arises as a small oval organ lying on the left of the ureter. Its wall consists of a layer of pyramidal gland cells with basal nuclei. These cells are disposed round a small lumen which communicates with the ureter.

    4. Reproductive system: The reproductive system (Fig. 30) consists of two testes and an accessory genital mass, lying between the right and the left hepatic lobes. The testes (Fig. 30, *b*) are solid and roughly spherical in shape, measuring about $60 \times 85 \,\mu$. Each is made up mainly of rapidly proliferating spermatogonia. Its periphery is bounded by an epithelium possibly derived from germ cells. Oogonia become by degrees distinguishable from the spermatogonia among which they lie, owing to their larger and more distinct nuclei, each of which carries a spherical nucleolus and clear nucleoplasm, scarce of chromatin. They are still few in number and are scattered near the periphery of the testis. The accessory genital mass (Fig. 30, *a*), lying close in front of the anterior testis, is a small canaliculiform organ whose epithelium is of columnar form with basal nuclei. It is the
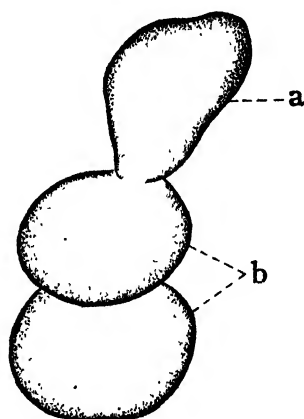
Fig. 30. Dorsal view of reproductive system of young specimen about 1 mm long (×300). *a.* accessory genital mass, *b.* testes.

rudiment from which genital ducts later develop.

4. Morphology of the Young Specimen about 2 mm long

At this stage the stomach is well-defined; the lumen of the accessory renal gland is lined with a ciliated epithelium: testes and ovaries become separate; the accessory genital mass differentiates into a hermaphrodite duct, a male duct with a penis sac and a female duct.

1. Digestive system: The radula contains about 30 rows of teeth. The common hepatic lumen is now defined by the stomach, the upper wall of which arises as an extension from the ciliated intestinal epithelium and the floor from the non-ciliated oesophageal epithelium. The older liver cells are often seen in process of being shed into the hepatic lumen.

2. Excretory system: As the accessory renal gland enlarges (Fig. 31), the free surfaces of the gland cells become by degrees covered by a series of proliferating nuclei, which later on give rise to a ciliated epithelium abutting on the lumen of the gland. This epithelium is continuous with the ureteric
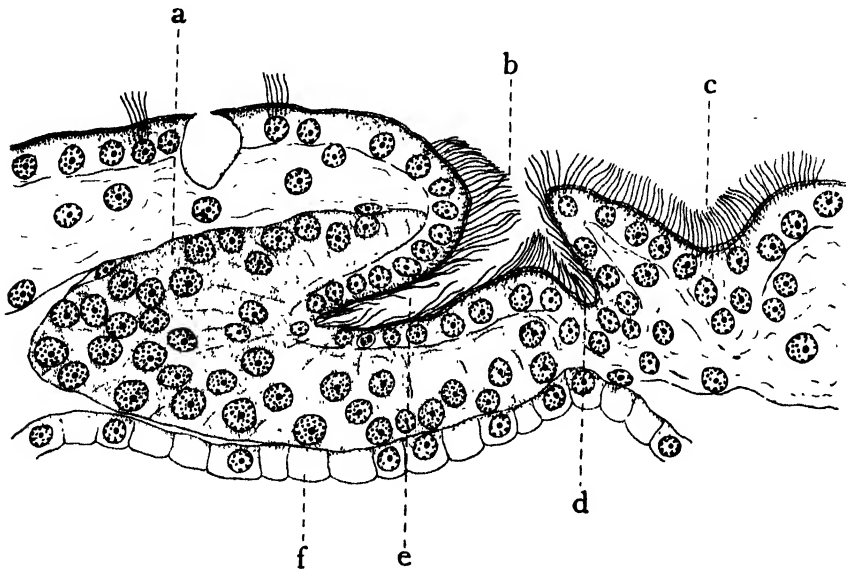
Fig. 31. Transverse section of young specimen about 2 mm long, showing accessory renal gland, ureter and nephroproct (×800). *a.* accessory renal gland, *b.* nephroproct, *c.* anus, *d.* ureter, *e.* lumen of accessory renal gland, *f.* kidney.

lining. The nuclei of the gland cells are as large as, or slightly larger than, those of the ciliated epithelium. In the course of further development the ciliated epithelium acquires a basement membrane, its nuclei decreasing considerably in size. The gland cells become flask-shaped with fine ducts and large basal nuclei.
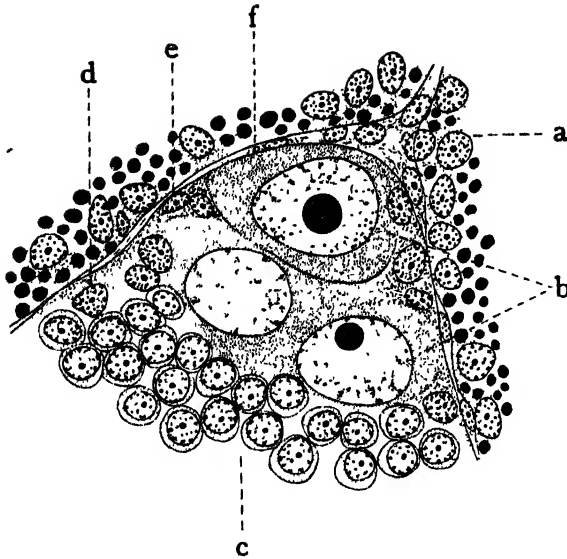
Fig. 32. Section of ovarian rudiment of young specimen about 2 mm long (×800). *a.* liver, *b.* oogonia, *c.* testis, *d.* testis epithelium, *e.* ovarian epithelium, *f.* ovarian rudiment.

3. Reproductive system:

While the testes remain solid, the increasing oogonia (Fig. 32, *b*) collect together towards certain places of each testis and bulge out there to form ovarian rudiments (Fig. 32, *f*) which are externally bounded by an extension of the testis epithelium. In this way the separation of ovaries from testes becomes clear: there arise usually three ovarian rudiments for the posterior testis and two for the anterior testis (Fig. 33). The small ducts which leave both of the testes soon unite to form a large common genital duct or hermaphrodite duct (Fig. 33, *c*). This latter extends a short distance forward and then divides into two large but short ducts. The left one is a male duct (Fig. 33, *f*) which anteriorly enlarges into a roomy penis sac (Fig. 33, *a*) overlying the origin of the oesophagus, close to the right body wall. The right one is a female duct (Fig. 33, *b*) leading forward into the right-ventral corner of the penis sac. The wall of the penis sac is made up of a ciliated columnar epithelium externally covered by abundant connective tissue cells.

5. Further Development of the Reproductive System

When the animal grows over 3 mm in length, almost all the viscera excepting the reproductive system are

Fig. 33. Dorsal view of reproductive system of young specimen about 2 mm long (×120). *a.* penis sac, *b.* female duct, *c.* hermaphrodite duct, *d.* testis, *e.* ovary, *f.* male duct.

so well established that there is no need of further description. Here the discussion is confined to the further development of the reproductive system which remains incomplete as late as the time when the animal attains a length of 4–5 mm.

A. In an animal, about 3 mm in length, the reproductive system (Fig. 34) consists usually of two testes accompanied by 5 ovaries ; a hermaphrodite duct ; a spermatocyst ; a female duct divided into an albumen and a mucous gland ; a male duct consisting of a prostata, a vas deferens and a penis sac ; and a vagina leading into the spermatheca.

1. Testis: It is now seen that the bulk of the testis is made up of the primary and the secondary spermatocytes in various phases of division. The successive decrease in size of testis cells results in the formation of a small lumen near the centre of the testis.

2. Ovary : Each ovary (Fig. 34, *f*) is in the form of a well-defined oval sac attached to the testis by a short stalk. It contains various-sized oocytes resting upon an ovarian epithelium, the

Fig. 34. Dorsal view of reproductive system of young specimen about 3 mm long (×120). *a.* penis sac, *b.* mucous gland, *c.* albumen gland, *d.* hermaphrodite duct, *e.* testis, *f.* ovary, *g.* spermatocyst, *h.* prostata, *i.* spermatheca, *j.* vas deferens.

youngest being those in the stalk and the oldest near the blind end of the ovary.

3. Hermaphrodite duct: The hermaphrodite duct, lined with a ciliated epithelium, is a slender tube as in the adult, and its foremost end bifurcates into a male and a female duct. At a point immediately behind the bifurcation, the hermaphrodite duct gives rise to a saccular rudiment of the spermatocyst (Fig. 34, *g*), the epithelium of which is composed of ciliated columnar cells.

4. Female duct: The albumen gland (Fig. 34, *c*) is a small curved duct leading into the mucous gland near its union to the penis sac, on the left side. The mucous gland (Fig. 34, *b*) is a short canalicular organ whose free poste-

rior end is blind. From the mucous gland, close to the entrance of the albumen gland, is given off an elongated canal which is divided into a basal and a distal half. The basal half represents the vagina of the adult, while the distal half with slightly swollen blind end is destined to give rise to a spermatheca (Fig. 34, *i*) and its stalk. The entire canal is made up of a ciliated epithelium.

5. Male duct: The distinction between the prostata (Fig. 34, *h*) and the vas deferens (Fig. 34, *j*) is now clear: the former is swollen and the latter slender. The ciliated epithelium of the vas deferens is externally bounded by a thick coat of muscle cells which are not yet well differentiated. The vas deferens plunges into the left dorsal corner of the penis sac, and the point of entrance is guarded by a dorsal and a left lateral valve-like outgrowth, which grows larger at the expense of abundant connective tissue cells covering the penis sac.

6. Histogenesis in the albumen gland, mucous gland and prostata: At first the nuclei of the ciliated cells do not differ much from those of the gland cells. Both are oval, lying near the base of the tall columnar epithelium. With the growth of the organs in question the nuclei of the ciliated cells, decreasing in size, make their way towards the superficial parts of the gland cells. Each ciliated cell then changes its form from columnar to wedge-shaped, with the broad ciliated surface abutting on the lumen of the organs. The gland cells retain large basal nuclei. They do not yet yield secretory granules.

B. In an animal about to mature, all the stages of spermatogenesis, namely, the primary and the secondary spermatocytes, spermatids and spermatozoa are observable in one testis, while oocytes in relatively small ovaries are still young. Thus the present species is to be regarded as protandrous, as are Aeolids, *Elysia* and some other Tectibranchs (Pelseneer, 1894). Risbec (1928) describes for *Vayssierea* that it is proterogynous. From between the penis sac and the mucous gland arise a male vestibulum and an oviduct. The male vestibulum is a thin-walled roomy canal which leaves the right side of the penis sac and leads towards the integumental epithelium where the male genital orifice is destined to open. The oviduct, with a corrugated wall, is also a roomy canal which leaves the anterior end of the mucous gland. and passes forward to join with the distal end of the male vestibulum. The slender curved vas deferens is coated with a thick layer of muscle cells. Both the spermatocyst and spermatheca are small and empty. The albumen gland, mucous gland and prostata have not yet come to the state yielding secretion. In general, however, all the organs of the reproductive system may be considered as almost established. When mature the genital orifices arise by the breaking up of the integumental epithelium overlying the distal ends of the male vestibulum and oviduct.

V. Summary

1. *Okadaia elegans* Baba, together with *Vayssierea caledonica* Risbec, belongs to the family Vayssiereidae (syn. Okadaiidae). This family is very distinct from the Fucolidae, and is to be classed within the holohepatic Nudibranchia mainly by virtue of the type of the radula and the absence of jaw-plates.

2. The notable peculiarities by which *Okadaia elegans* Baba is regarded as aberrant among the Nudibranchia are: (1) the small limaciform body without gills; (2) the liver divided into 3–4 lobes; (3) the true heart not enclosed within a pericardium; (4) gonads consisting of 2–3 testes and 5–6 ovaries; and (5) the direct development.

3. *Okadaia elegans* Baba is one of the commonest Nudibranchia on the Pacific side of Japan. It frequents the intertidal zone, feeding upon tiny *Spirorbis* spp. Sometimes it is seen to be infested by Ciliates and Nematodes.

4. The egg-band is broad and flat, turned sidewise. It contains from 3 to 23 eggs, which are large relative to the size of the animal. Each egg is spherical in form and of an orange-yellow colour, and has a transparent egg-capsule. It develops into a blastula and then into a gastrula. This latter is cap-like in form and has a blastopore at its vegetal pole. Soon the gastrula changes into a characteristic veliger with a small stomodeal invagination in front. This veliger has two dorsal humps, an anterior and a posterior. The anterior dorsal hump is not bilobed, but bears cilia on the front surface, thus representing a rudimentary velum. The veliger itself has a small ciliated foot, but is devoid of an operculum and a shell. The veliger transforms into a larval form similar to the adult while still in the egg-capsule. It takes about 18–19 days before the larva escapes from its own egg-capsule.

5. The larva or young immediately after hatching measures about 0.6 mm in length, and has an external form of the adult. The well-marked visceral organs are: (1) the pharyngeal bulb loaded with a central nervous system; (2) the liver in the form of a single sac; (3) the anal organ; and (4) the massive undifferentiated gonad without genital ducts. In general, all the visceral organs of the young in question, excepting the central nervous system, are incomplete. And some of the organs such as the accessory renal gland and genital orifices are not yet generated.

6. With the growth of the animal, the digestive, circulatory and excretory organs develop quite rapidly. It is the stage when the animal attains a length of about 3 mm that their general structure assumes that of an adult. The gonad gradually continues development till it is differentiated into testes, ovaries and accessory genital organs. When mature there open genital orifices on the right body-side a short distance behind the head. The animal is protandrous.

7. The development of the digestive organs is initiated by a stomodeal invagination. Then the liver and anal organ become conspicuous towards the last stage of the veliger. At first the former takes the form of an unpaired saccular mass (in most Opisthobranch veligers the liver arises as paired lobes).

The separation of the liver into 3–4 lobes takes place in the young animal a short while after hatching. The stomach is late in appearing. Its upper wall arises as an extension from the intestinal epithelium and the floor from the oesophageal epithelium. The liver is active in secreting digestive ferments. Some older cells of the liver appear to serve as excretory cells. In the adult the digestive system consists of the stomodaeum, pharyngeal bulb, oesophagus, stomach, liver lobes, intestine and rectum accompanied by an anal organ. The radula formula for one row is 3. 0. 3. Jaw-plates are wanting.

8. The central nervous system, consisting of the cerebral, pleural, pedal and buccal ganglia, with sense organs such as eyes and otocysts, is very early in appearing. It is already well developed in the larva ready to hatch. The rhinophores have each a subepithelial ganglion layer. The so-called oral tentacles are absent. But the integuments on both sides of the mouth form special sensitive areas supplied by oral nerves.

9. The circulatory system consists of a heart, a haemocoele and abundant lacunae. The heart is never a specialized portion of the kidney as erroneously described in my previous paper (Baba, 1931), but has its own structure. It is very rudimentary in constitution, possibly in connection with the disappearance of the ctenidium. There are no blood-vessels and pericardium. The heart is two-chambered. It is blind in front but is wide-open behind.

10. The kidney is visible in the youngest animal immediately after hatch-ing as a simple longish organ with a short ureter leading to the left of the anus. It is at first solid, but later acquires a lumen. Soon a rudiment of the accessory renal gland appears close to the left of the ureter. This becomes more and more marked with continued growth. The anterior portion of the kidney never develops into a pulsatory heart. The reno-pericardial canal in most Opisthobranchs is represented here by a reno-coelomic canal which connects the haemocoele with the kindey.

11. In the youngest animal immediately after hatching, the primitive gonad appears as a solid mass of germ cells. This gonad gradually divides into two testes and one accessory genital mass. Then there arise ovarian rudiments on certain places of the testis surface. Synchronously with this change the accessory genital mass differentiates into a common genital duct (hermaphrodite duct), a male duct with a penis sac, and a female duct con-nected with the penis sac. With continued growth the testes become more marked. The spermatocyst arises as a saccular organ from the anterior portion of the hermaphrodite duct. The male duct differentiates into a prostata and a vas deferens, while the female duct itself develops into an albumen gland and a mucous gland. From the mucous gland is given off an elongated canal which later differentiates into a vagina and a spermatheca with its stalk. In an animal about to mature there arise a male vestibulum and an oviduct from between the penis sac and the mucous gland. When mature the male and the female orifices open by the breaking up of the integumental epithelium just above the distal ends of the male vestibulum and oviduct.

Correction of Previous Errors

The previous discussions regarding the renal heart (Baba, 1931.— p. 64, line 28; p. 70, lines 22–35, p. 71, lines 1–3; p. 76, lines 24–35; p. 77, lines 24–28; text-fig. 1, v; pl. 5, fig. 3, f) and the disappearance of a heart (l.c. p. 64, lines 3-4, 25; p. 70, lines 8–10; p. 78, lines 6–8; p. 79, lines 2, 12; p. 80, line 1) are withdrawn. The reno-coelomic canal and ureter (l.c. p. 71, lines 4–19) are recognized as arising from the kidney. The term renal heart (l.c. pl. 5, fig. 1, a, n; fig. 2, a; pl. 7, fig. 12, a) is altered to kidney.

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9. Studies on Japanese Mysidacea

III. Descriptions of Four New Species belonging to Tribes, Leptomysini and Erythropini

By Naoyosi Ii

Fisheries Institute, Faculty of Agriculture, Tokyo Imperial University

(With Text-figures 1–60)

Tribe Leptomysini H. J. Hansen, 1910

Genus *Prionomysis* Tattersall, 1922

Prionomysis aspera n. sp.

Figures 1–14.

LOCALITIES. Aziro, Sizuoka Prefecture (presented by Mr. H. Aikawa). Type specimen. 9 males, 13 females, 7–10 mm. Misaki, Kanagawa Prefecture. 1 male, 10 mm.

DESCRIPTION. Body densely beset with minute spinules all over the surface; the spinules extending to the eye-stalks, antennulae, antennae, mouth parts, thoracic limbs, pleopods, telson and uropods.

Front margin of the carapace produced into a short triangular rostral plate, apex extends forwards slightly beyond the base of antennular peduncle, the angle of the apex acute but the tip bluntly rounded. Antero-lateral corners of the carapace rounded. Last 2 thoracic somites exposed dorsally.

Eyes, including the stalk, large, slightly longer than broad and extending almost to the end of the second joint of antennular peduncle, cornea occupying half of the entire eye in dorsal view, the stalk densely beset with spinules and provided with a blunt spiniform process on dorsal side just as in *Neomysis spinosa* Nakazawa.

Antennular peduncle in the male, stout, with the first joint almost as long as the 2 distal joints combined. In the female the peduncle somewhat slender than in the male, with the first joint slightly longer than the 2 distal joints combined. The peduncle and proximal parts of the flagella densely beset with spinules, the spinules on the third joint longer and stouter than those on any other parts. Male sexual appendage well developed and almost as long as the third joint in dorsal view.

Antennal scale about 11 times as long as broad, in the male slightly shorter than twice the length of the antennular peduncle, but in the female
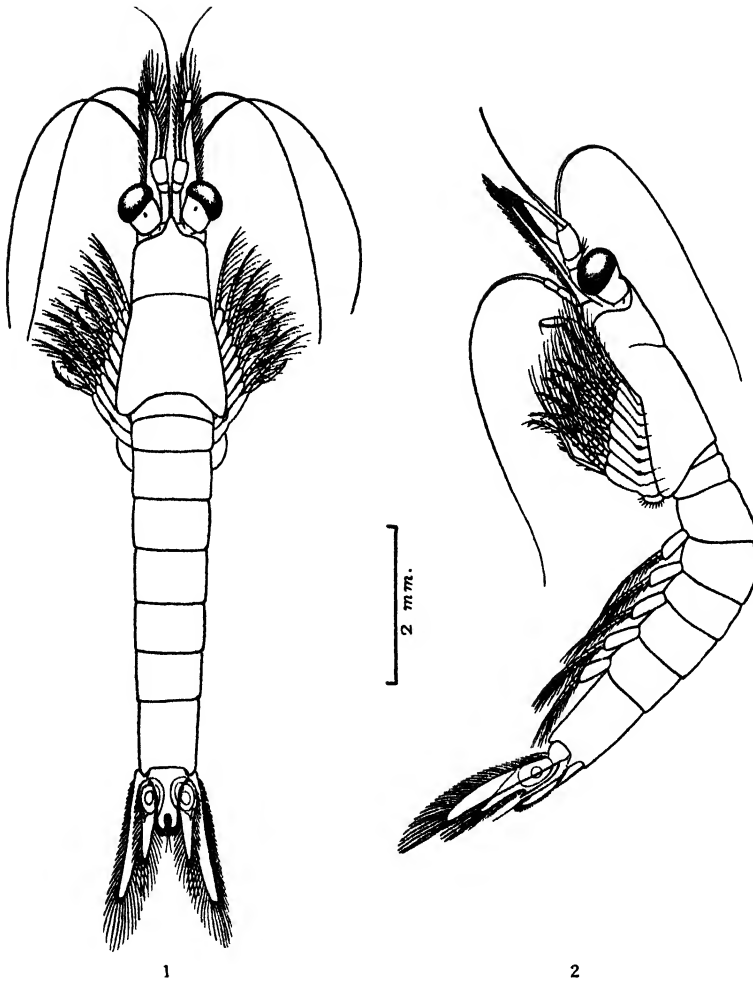
Figs. 1–2. *Prionomysis aspera* n. sp.

Fig. 1. Dorsal view of adult female.
Fig. 2. Lateral view of adult male.

about twice as long as the antennular peduncle; the distal joint $^1/_{15}$ of the entire length of the scale; basal joint, from which the scale arises, with a spine on the outer distal corner. Antennal peduncle about $^1/_3$ as long as the scale. The scale, peduncle and proximal part of the flagellum densely beset with spinules.

Labrum without spiniform process, the anterior margin produced into a short triangular process with rounded apex in ventral view.

Mandible with well developed masticatory surface, palp beset with spinules.
First maxilla presents no feature of special interest.
Second maxilla with the endite of the second joint fused into a setiferous
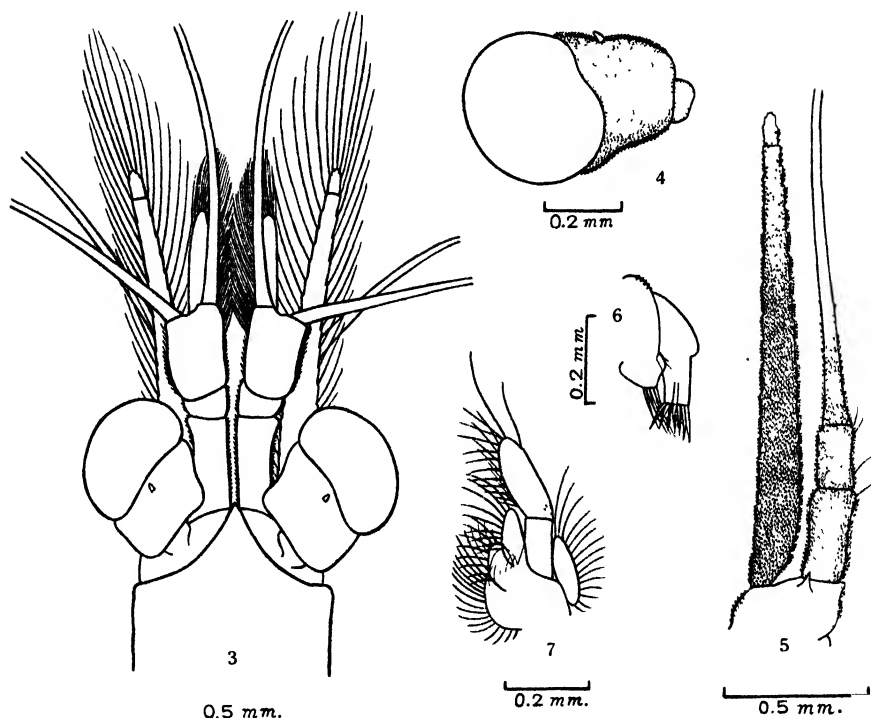
Figs. 3–7. *Prionomysis aspera* n. sp.

Fig. 3. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.

Fig. 4. Eye, lateral view to show the spiniform process and the spinules on the stalk.

Fig. 5. Antennal scale and peduncle.

Fig. 6. First maxilla.

Fig. 7. Second maxilla.

expansion of the lobe, instead of 2 lobes; the terminal joint of the palp long and narrow, its outer margin without spines; the proximal part of the joint provided with a few spinules.

First thoracic limbs with a small masticatory lobe only on the second joint, no lobes on the third and fourth; nail long and robust.

Second thoracic limbs with a nail long and robust.

Third to the eighth thoracic limbs with propodite divided into 3 joints. Basal plate of the exopod of all thoracic limbs with bluntly pointed distal outer corner. The spinules on the thoracic limbs slightly larger in size on the anterior surface than on the posterior surface in both exopod and endopod.

Female with 3 pairs of oostegites.

The sixth abdominal somite $1^2/_3$ times as long as the fifth.

First pleopod of the male with broad basal joint armed with about 9 long plumose setae along the ventral median line; exopod well developed and 8-jointed; endopod rudimentary, slightly shorter than the first joint of the
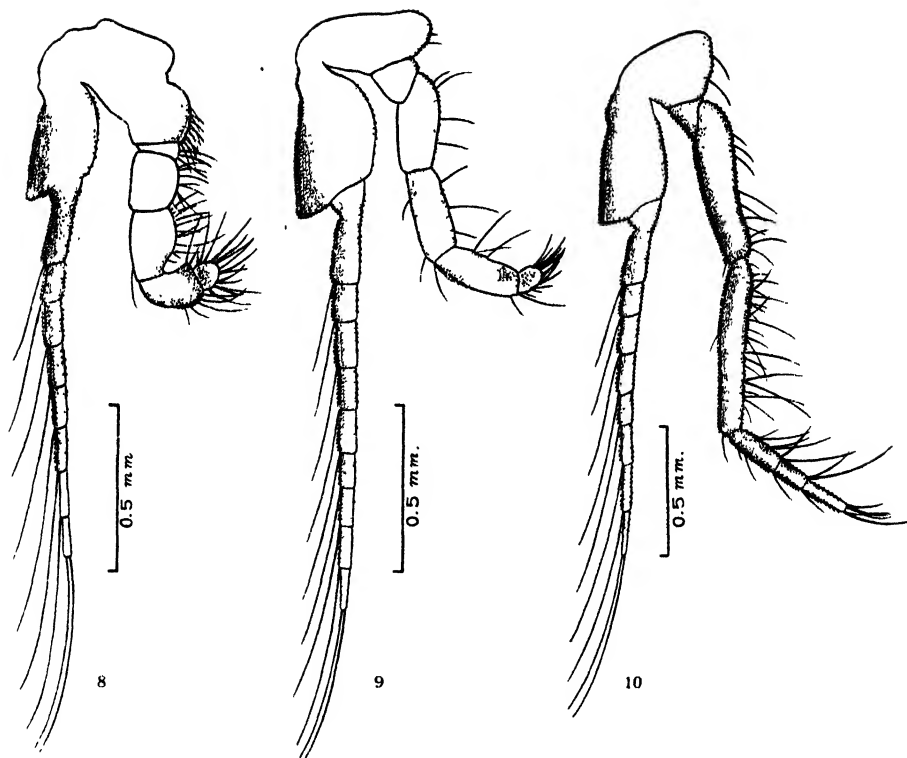
Figs. 8–10. *Prionomysis aspera* n. sp.

Fig. 8. First thoracic limb.
Fig. 9. Second thoracic limb.
Fig. 10. One of the posterior thoracic limbs.

exopod, but with well developed side lobe.

Second, third and fifth pleopods are similar in form; endopod 8-jointed, with well developed side lobe; exopod 9-jointed, slightly longer than the endopod, 1 joint projecting beyond the tip of the endopod.

Fourth pleopod with 8-jointed endopod with well developed side lobe, exopod 11-jointed, $1^2/_5$ times as long as the endopod, 3-joints projecting beyond the tip of the endopod, each of the antepenultimate and penultimate joints armed with a long and stout spinous seta, the ultimate joint terminated by 2 short simple setae.

Telson slightly shorter than the last abdominal somite and almost $1^2/_3$ times as long as broad at base; lateral margins gradually narrowing for about $^2/_3$ of its length and then slightly widening and terminating in 2 lobes separated by a median wide cleft; the cleft about $^1/_5$ of the length of the whole telson, wider proximally than distally, the bottom of the cleft rounded, margin unarmed except for 2 long plumose setae at the bottom, the plumose setae about $2^3/_5$ times as long as the cleft; the lateral margins of the telson
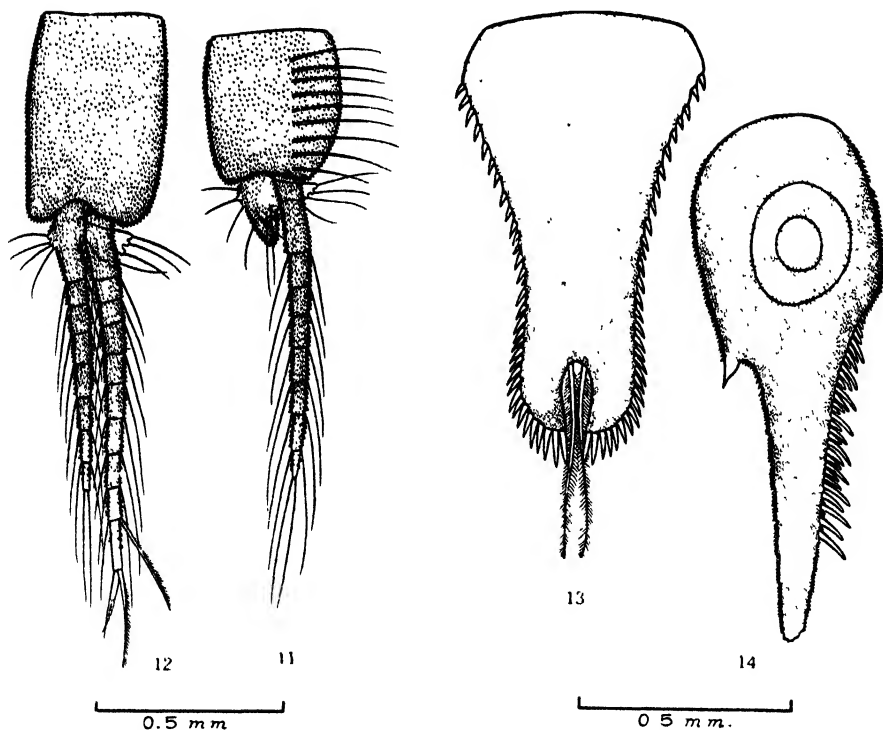
Figs. 11-14. *Prionomysis aspera* n. sp.

Fig. 11. First pleopod of the male.
Fig. 12. Fourth pleopod of the male.
Fig. 13. Telson.
Fig. 14. Inner uropod.

armed throughout their entire length with spines, about 17 small spines on the proximal part of the margin from the base of the telson to the narrowest part, from the narrowest part to the apex of each lobe there are about 16 closely packed spines, which are longer than those on the proximal portion of the margin and increasing in size towards the apex.

Inner uropod $1^1/_2$ times as long as the telson with a very prominent and acute spine on the dorsal surface of outer posterior margin of statocyst, the spine is very prominent in lateral view; inner margin armed with a dense row of about 30 bluntly pointed spines, extending from the statocyst slightly beyond the $^1/_3$ point from the apex, arranged in series of larger and shorter ones, 1-3 in each series; the statocyst large.

Outer uropod twice as long as the telsen.

REMARKS. The present species is very closely allied to *P. stenolepis* Tattersall (1922), the type and only species of the genus described from Port Blair, Andaman Isles.

It is, however, easily distinguishable from *P. stenolepis* in having the spinules covering all over the body and appendages.

The present species also slightly differs from *P. stenolepis* by the relatively shorter rostrum and antennal scale and by the presence of the tiny blunt spiniform process on the eye-stalk and of the plumose setae on the basal joint of the first pleopod. It further differs slightly in the fourth pleopod and the telson as follows:

In the present species the fourth pleopod of the male with 8-jointed endopod and 11-jointed exopod with ultimate joint terminated by 2 short simple setae, while in *P. stenolepis* the fourth pleopod with both endopod and exopod 6-jointed and the ultimate joint of the exopod with a stout spinous seta as in the antepenultimate and penultimate joints.

In the present species the lateral spines of the telson are slightly less in number than in *P. stenolepis*. There are about 17 spines on the proximal part of the margins from the base of the telson to the narrowest part in both species, from the narrowest part to the apex of each lobe there are about 16 spines in this species, while in *P. stenolepis* there are about 25.

Genus *Tenagomysis* G. M. Thomson, 1900

(= *Theganomysis* Zimmer, 1918)

Tenagomysis orientalis n. sp.

Figures 15-30.

LOCALITY. Aziro, Sizuoka Prefecture.

Type specimen. Abundant adult males and females (presented by Mr. H. Aikawa).

DESCRIPTION. Carapace leaving last 2 thoracic somites exposed; front margin produced into a short triangular rostral plate with broadly rounded apex; antero-lateral corners rounded.

Eyes of moderate size, about twice as long as broad, cornea occupying about $^2/_3$ of the entire eye in dorsal view.

Antennular peduncle in the male with the first joint almost as long as the third; male sexual appendage about half as long as the third joint. In the female the antennular peduncle with the first joint almost as long as the 2 distal joints combined.

Antennal scale almost as long as the antennular peduncle, narrowly lanceolate in shape, about 9 times as long as broad, 2-jointed, distal joint about $^1/_9$ of the entire length of the scale; basal joint, from which the scale arises, with a spine on outer distal corner.

Antennal peduncle extending slightly beyond the first joint of the antennular peduncle and almost half as long as the scale.

Labrum provided with a long forwardly directed spine, the tip of the spine extending to the end of the second joint of the palp of mandible.

Mandible and first maxilla present no feature of special interest.

Second maxilla with the terminal joint of the palp longer than broad, the outer margin of the joint armed with about 11 strong spines.
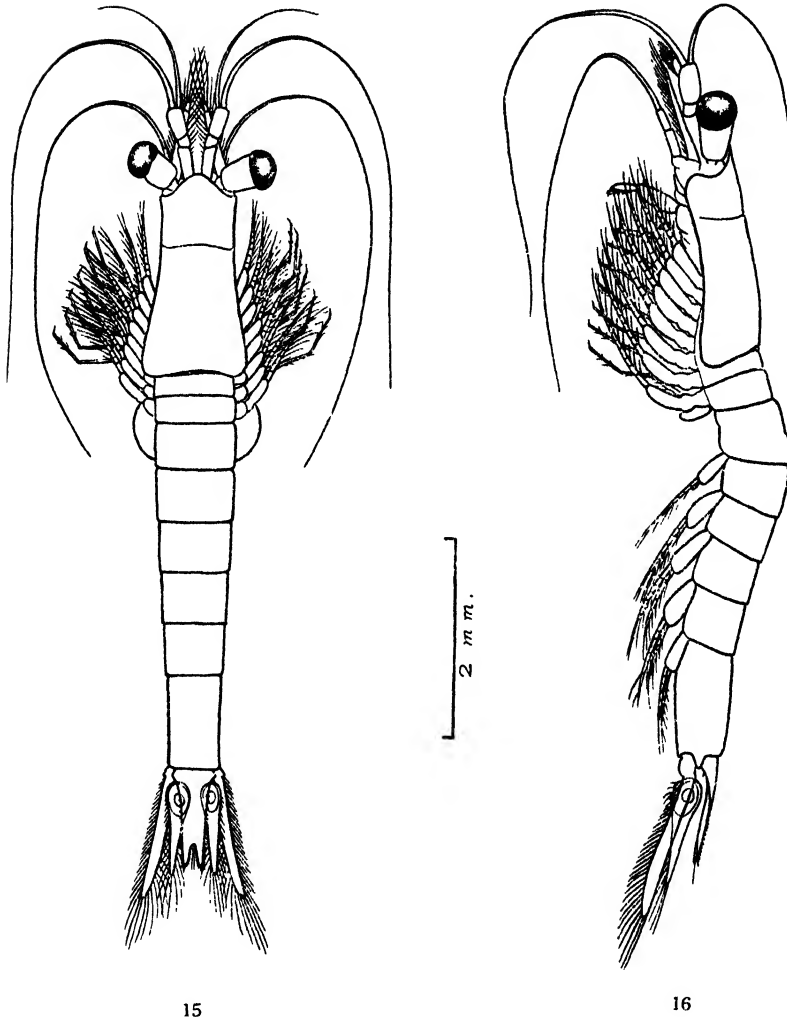
15   16

Figs. 15–16. *Tenagomysis orientalis* n. sp.

Fig. 15. Dorsal view of adult female.
Fig. 16. Lateral view of adult male.

First thoracic limbs with well developed masticatory lobes on the second, third and fourth joints.

Third to the eighth thoracic limbs with propodite divided into 3 joints. Distal outer corner of the basal plate of the exopod of the thoracic limbs provided with a tiny spine in the first and second limbs but rounded in all the succeeding ones.

Female with 3 pairs of oostegites.

First abdominal somite with an obscure transverse grooves on dorsal side at the middle. Sixth abdominal somite about $1\frac{2}{3}$ times as long as the fifth.
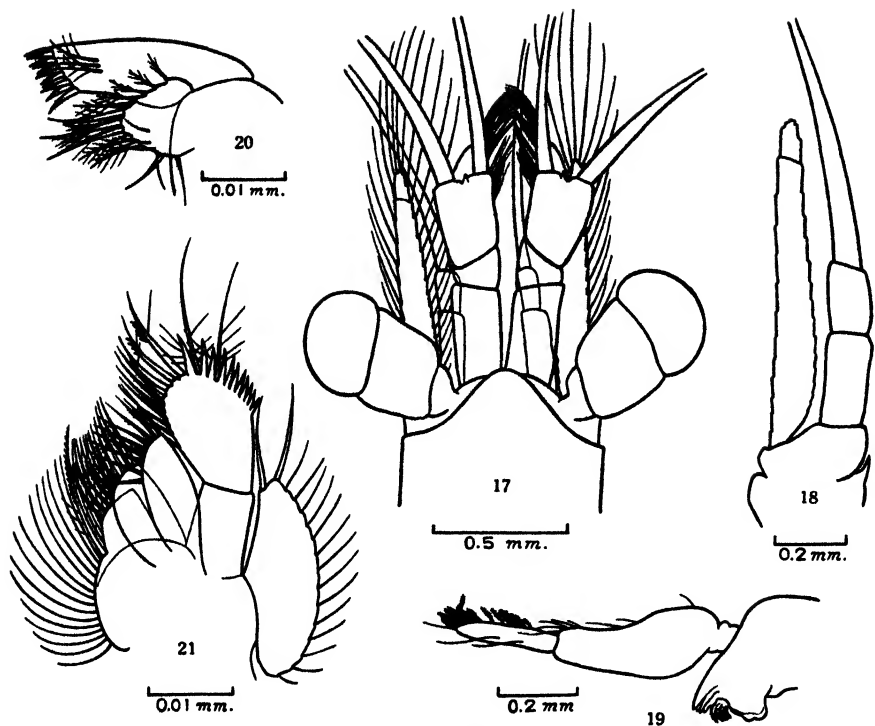
Figs. 17-21. *Tenagomysis orientalis* n. sp.

Fig. 17. Anterior end of a male to show rostral plate, eye, antennule
         and antennal scale.
Fig. 18. Antennal scale and peduncle.
Fig. 19. Mandible and palp.
Fig. 20. First maxilla.
Fig. 21. Second maxilla.

First pleopod of the male with 7-jointed exopod; endopod rudimentary,
very short and about half as long as the first joint of the exopod.

Second, third and fifth pleopods similar in form; endopod 6-jointed;
exopod 7-jointed and slightly longer than the endopod.

Fourth pleopod with 6-jointed endopod; exopod 7-jointed, about $1^1/_3$ times
as long as the endopod, 2 joints projecting beyond the tip of the endopod, the
penultimate joint about $1^1/_3$ times as long as the antepenultimate and about
$2^3/_4$ times as long as the ultimate, each of the antepenultimate and penulti-
mate joints armed with a long and stout spinous seta, the ultimate joint
terminated by 2 short simple setae.

In the pleopods of the male a setiferous lobe, which is characteristic of
the endopod of the pleopods of Mysidae, well developed at the base of the
endopod; the lobes on the first and fifth pairs narrow and normal in shape,
but those on the second, third and fourth pairs more or less swollen at the
posterior margin, the swollen part devoid of setae and somewhat recalls the
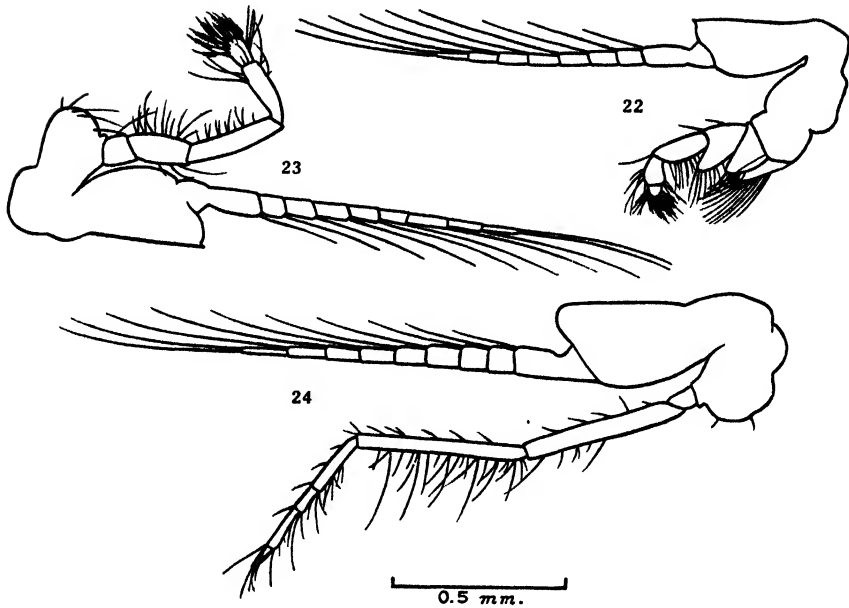
Figs. 22-24. *Tenagomysıs orientalis* n. sp.

Fig. 22. First thoracic limb.
Fig. 23. Second thoracic limb.
Fig. 24. One of the posterior thoracic limbs.

branchial plates on the pleopods of the species of *Hypererythrops*. In the fifth pleopod besides the lobe there is a conical process at the middle of the first joint of the endopod closely posterior to the usual lobe; the process directed parallel with the lobe, about half as long as the lobe and bears a short seta on the tip.

Telson about $1^1/_5$ times as long as the last abdominal somite and about $2^1/_2$ times as long as broad at the base, cleft for $^1/_5$–$^1/_4$ of its length; the cleft wide, almost equal width throughout, rounded at the bottom, armed with 26–40 teeth on each margin and with 2 plumose setae at the bottom, the plumose setaé about as long as the cleft; terminal lobes of more or less equal width throughout; lateral margins of the telson armed with about 20 small spines, in the proximal $^1/_3$ of the margins the spines very widely spaced and in the remaining part they are closely and regularly placed, the lateral spines are all of even size except the terminal large spines.

Inner uropod slightly longer than the telson, its inner margin armed with a dense row of about 70 spines extending from the statocyst to the apex, large and small spines alternate, 1–5 small ones between two large.

Outer uropod $^2/_5$ longer than the telson.

Length of adult specimens of both sexes, 8 mm.

REMARKS. The present species belongs to Tattersall's group II, characterized by the rounded antero-lateral corners of the carapace, and very closely allied

0.5 mm.
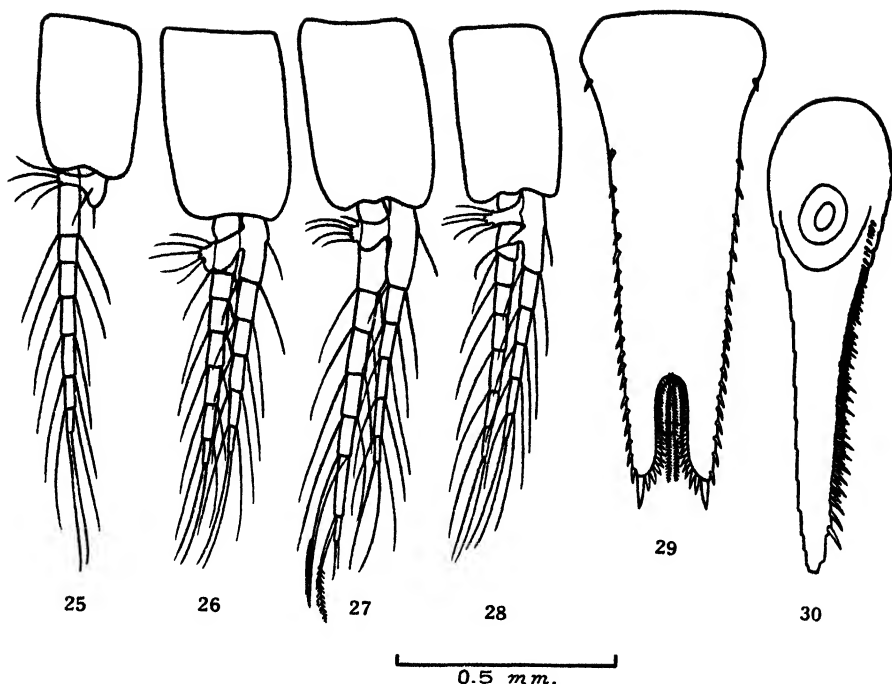
Figs. 25–30. *Tenagomysis orientalis* n. sp.

Fig. 25. First pleopod of the male.
Fig. 26. Second pleopod of the male.
Fig. 27. Fourth pleopod of the male.
Fig. 28. Fifth pleopod of the male.
Fig. 29. Telson.
Fig. 30. Inner uropod.

to *T. thomsoni* from which it is distinguishable by the number of joints of propodite, the relative length of antennal peduncle, the shape of the telson and by the number of spines on the margins of the telson and its cleft and on the inner uropod.

The shape of the cleft of the telson with almost equal width throughout and with the rounded bottom will serve to distinguish the present species from all other species of the genus.

All of the 9 hitherto described species of this genus have been known only from the neighbourhood of New Zealand. The occurrence of this genus in the waters of Japan is a matter of interest.

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Tribe Erythropini H. J. Hansen, 1910

Genus *Holmesiella* Ortmann, 1908

Holmesiella affinis n. sp.

Figures 31–45

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LOCALITY. 126°7′ E. L., 32°16′ N. L., East China Sea (presented by Mr.

H. Aikawa).

Type specimen.   30 males, 16 females, up to 15 mm.

DESCRIPTION.   Front margin of the carapace produced into a short triangular rostral plate, but the carapace leaves the whole of the eye-stalks and antennules uncovered ; angle of the apex of the rostrum acute but the tip obtusely rounded. Antero-lateral corners of the carapace acutely pointed.

Eyes, including the stalk, about as long as broad, cornea occupying about half of the entire eye in dorsal view, pigment dark magenta.

Antennular peduncle stout; the third joint swollen and about $1^1/_2$ times as thick as the preceding ones in both dorsal and lateral views. In the male the third joint about as long as the 2 proximal joints combined, but in the female it is about as long as the first joint.   Male sexual append-age well developed, conical and about $^2/_3$ of the length of the third joint.

Antennal scale $1^2/_3$ times as long as the antennular peduncle and $4^1/_4$ times as long as broad ; outer margin entire, terminal lobe slightly shorter than broad at its base and about $1^2/_3$ times as long as the terminal spine on the outer margin. Basal joint, from which the scale arises, with a spine on the outer corner.

Antennal peduncle about half as long as the scale; the third joint ovate in shape, about $1^2/_3$ times as long as broad, articulated to the second joint on its own ventral margin and the proximal $^1/_3$ of the joint overhanging the second joint in dorsal view ; the second joint about as long as the third and abruptly narrowed at the distal end.

Labrum without spiniform process, but with bluntly rounded conical protubernace.

Mandible with well developed cutting edge.

First and second maxilla show no feature of special interest.

First thoracic limbs with well developed lobes on the second, third and fourth joints.

Second thoracic limbs long and slender ; the sixth joint long.
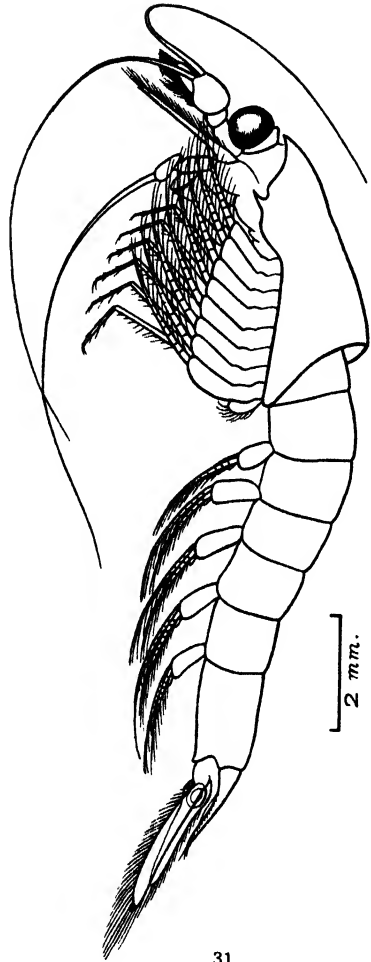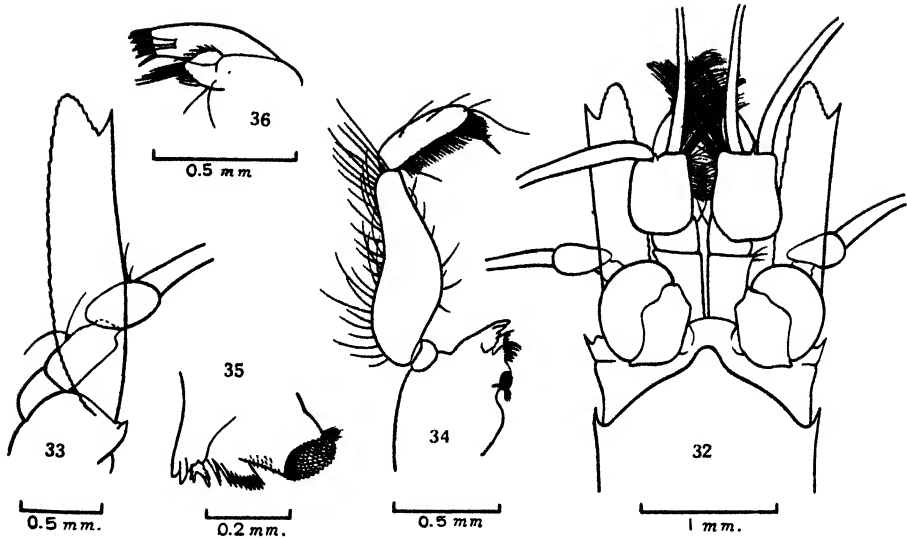
Figs. 32–36. *Holmesiella affinis* n. sp.

Fig. 32. Anterior end of a male to show rostral plate, eye, antennule, antennal scale and peduncle.
Fig. 33. Antennal scale and peduncle.
Fig. 34. Mandible and palp.
Fig. 35. Cutting edge of the mandible.
Fig. 36. First maxilla.

Third to the eighth thoracic limbs long and slender, carpopodite long, propodite divided into 3 joints, the first articulation being somewhat oblique. Basal plate of the exopod with the outer distal corner rounded. Small knob-like process on the inner margin of the basal joint of the endopod of the third to the eighth thoracic limbs, but not on the first and second, the process seems to be correspond to the finger-like process, which was described on the same part of the species of the genus *Mysidopsis* and interpreted by Zimmer as gill process.

Sixth abdominal somite $1^3/_4$ times as long as the fifth.

Fourth pleopod of the male with the endopod longer than the exopod; endopod about $1^1/_4$ times as long as the exopod; joints on the endopod slightly increasing in length distally but the distal joints not extremely elongated as in *H. anomala*, and all the joints, except the ultimate joint, armed with plumose setae as usual, the ultimate joint bears at its end a stout and long spinous seta, which are about $^7/_{10}$ of the total length of the endopod, and a small spine at the base of the seta.

Telson triangular in shape, slightly shorter than the last abdominal somite and $1^2/_3$ times as long as broad at the base; lateral margins without spines in the proximal half, the distal half of the margins armed with about 14 regularly arranged spines, increasing in length toward the apex, the apex narrowly truncate and bears a pair of long spines, which are about $^1/_4$ of the
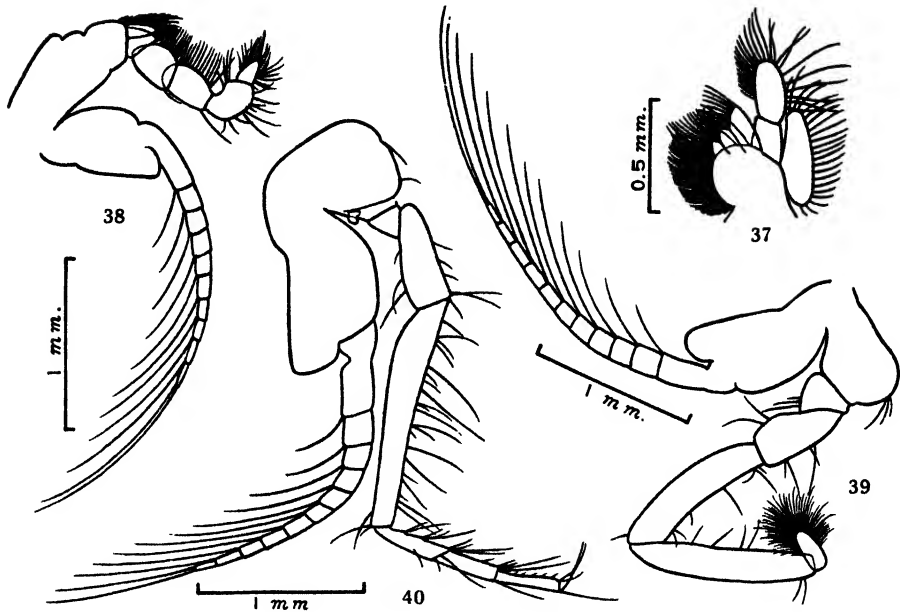
Figs. 37–40. *Holmesiella affinis* n. sp.

Fig. 37. Second maxilla.
Fig. 38. First thoracic limb.
Fig. 39. Second thoracic limb.
Fig. 40. One of the posterior thoracic limbs.

length of the telson and about $1^2/_3$ times as long as the last pair of lateral spines, between the long spines are a pair of quite small spines and a pair of long plumose setae, which are about as long as the long spines.

Inner uropod about $1^1/_2$ times as long as the telson; the inner margin armed with 5 spines near the statocyst, the spines grow gradually longer posteriorly and the most distal one lies somewhat more remotely situated from the preceding one than the others do.

Outer uropod about twice as long as the telson.

REMARKS. This interesting species belongs to the genus *Holmesiella* and is very closely allied to the type and only species of the genus, *H. anomala* Ortmann (1908) captured from Vancouver Island, Western Canada, and especially to Tattersall's (1933) specimens from the same locality.

It is distinguishable from *H. anomala* by the unique shape of the third joint of the antennal peduncle, by the fourth pleopod of the male with much shorter distal joints and by the presence of the knob-like process on the basal joint of endopod of the third to the eighth thoracic limbs.

The present species is smaller than *H. anomala* in size; the male specimens, apparently mature, measure only 15 mm and none of the specimens reaches the size of Ortmann's largest female, 40 mm, or that of Tattersall's male, 24 mm.

In the present species the distal joints of the endopod of the fourth pleopod
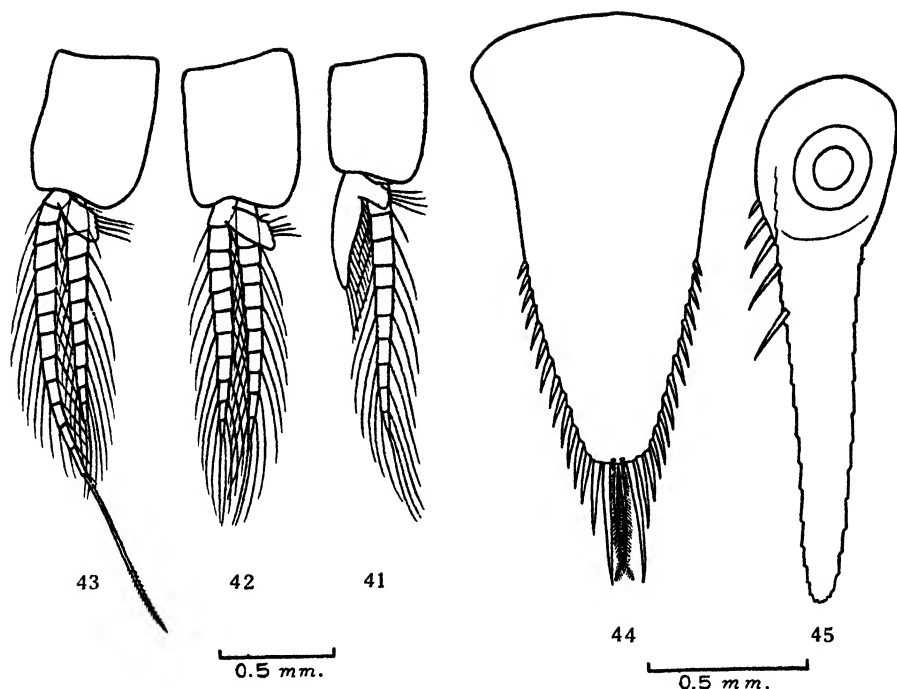
Figs. 41–45. *Holmesiella affinis* n. sp.

Fig. 41. First pleopod of the male.
Fig. 42. Second pleopod of the male.
Fig. 43. Fourth pleopod of the male.
Fig. 44. Telson.
Fig. 45. Inner uropod.

increase in length scarcely, not unduly elongated, and provided with plumose setae as usual, while in *H. anomala* the distal 3 joints, especially the terminal joint, abruptly increase in length and are destitute of setae. The armature of the terminal joint of endopod of the fourth pleopod in the present species agrees absolutely with that in Tattersall's specimens of *H. anomala*, but the proportion between the length of the joint and seta differs considerably.

Ortmann describes the pleopods in young males of *H. anomala*, as follows: " In the young males the pleopods are not so strongly developed; in the second, third and fifth the inner branch is distinctly longer than the outer (two or three joints projecting beyond the tip of the outer), and the inner branch of the fourth is not so greatly elongated, although the remarkable increase in length of the distal joints is distinctly indicated," while in young males of the present species, which measure 9 mm, the second, third and fifth pleopods with inner branch hardly longer than the outer and the distal joints of the inner branch of the fourth hardly increase in length.

Ortmann, in his diagnosis of the genus *Holmesiella*, describes the fourth pleopod of male as follows: " Inner branch about twice as long as the outer.

The terminal joints increase in length, and especially the last one is much elongated, almost three times as long as the penultimate. The three last joints do not possess any setae." I think, however, that it is better to consider these characters as species-specific characters.

Genus *Hypererythrops* Holt & Tattersall, 1905

Hypererythrops zimmeri n. sp.

Figures 46-60.

LOCALITY. Misaki, Kanagawa Prefecture.

Type specimen. 2 males, 8 females. 6 mm. (presented by Messrs. Y. Ohsima and Y. Hiyama).

DESCRIPTION. Carapace leaving the whole of the eyestalks and antennules uncovered; front margin of the carapace produced into a short triangular rostral process with obtusely rounded apex, to the outside of the eyestalks the front margin prolonged into a sharp supra-ocular spines; the lower anterior corners of the carapace rounded.

Eyes large, depressed, and extending to the distal end of the first joint of antennular peduncle; cornea large, stalk triangular in dorsal view and provided with a tiny blunt spiniform process on dorsal side.

Antennular peduncle in the male stout, the first joint about as long as the third; male sexual appendage well developed and conical. In the female the antennular peduncle somewhat slender than in the male, the first joint about as long as the 2 distal joints combined.

Antennal scale slightly longer than the antennular peduncle and about $4^1/_2$ times as long as broad, with small distal joint, outer margin smooth, terminating in a strong spine distally, terminal lobe

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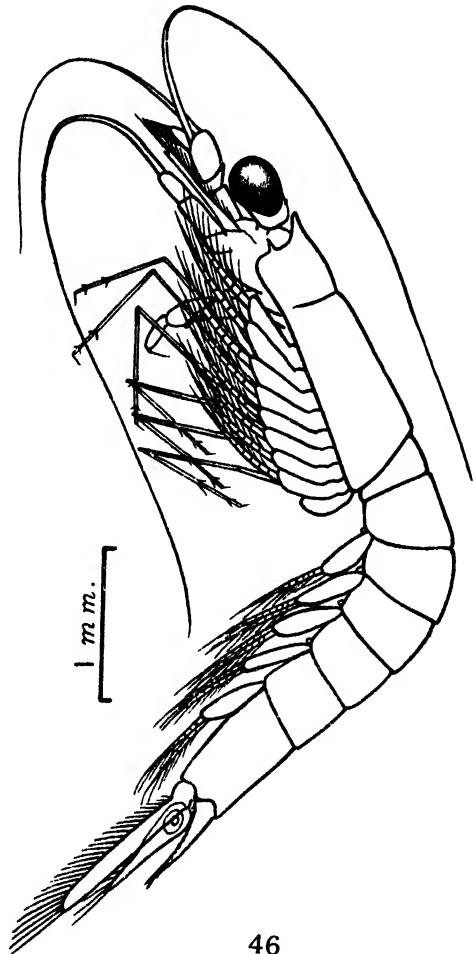
Fig. 46. *Hypererythrops zimmeri* n. sp. Lateral view of adult male.

as long as broad, about $^1/_7$ of the entire length of the scale and 2 times as long as the terminal spine. Basal joint, from which the scale arises, with a spine on both inner and outer corners.
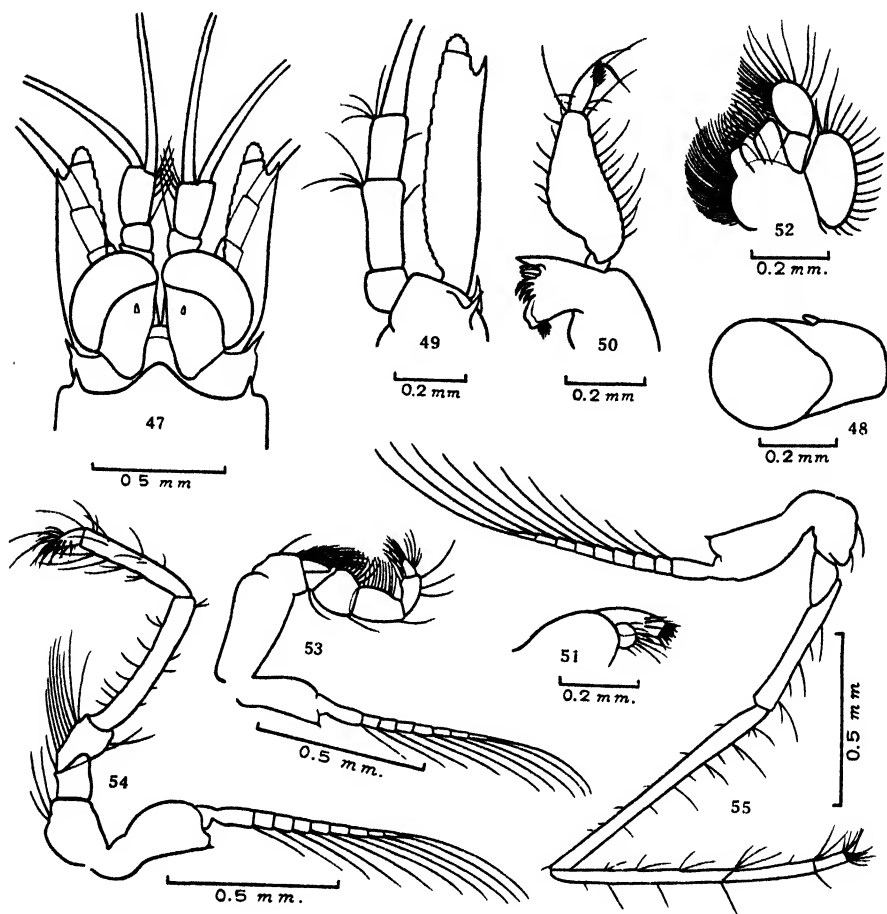
Figs. 47–55. *Hypererythrops zimmeri* n. sp.

Fig. 47. Anterior end of a female to show rostral plate, eye, antennule and antennal scale.

Fig. 48. Eye, lateral view to show the spiniform process on the stalk.

Fig. 49. Antennal scale and peduncle.

Fig. 50. Mandible and palp.

Fig. 51. First maxilla.

Fig. 52. Second maxilla.

Fig. 53. First thoracic limb.

Fig. 54. Second thoracic limb.

Fig. 55. One of the posterior thoracic limbs.

Antennal peduncle about $^2/_3$ of the length of the scale.

Mouth parts show no feature of special interest.

First thoracic limbs with lobes on the second, third and fourth joints.

Third to the eighth thoracic limbs slender, endopod longer than twice the length of the exopod, propodite divided into 3 joints, proximal articulation oblique. Basal plate of exopod of all thoracic limbs with a spine on the outer distal corner.

Female with 3 pairs of oostegites.

In the male the sterna of the last 6 thoracic somites are furnished with long sharply pointed forwardly directed spinous process as in *H. spinifera*. The sterna of the first 4 abdominal somites are furnished with simple papilliform process.
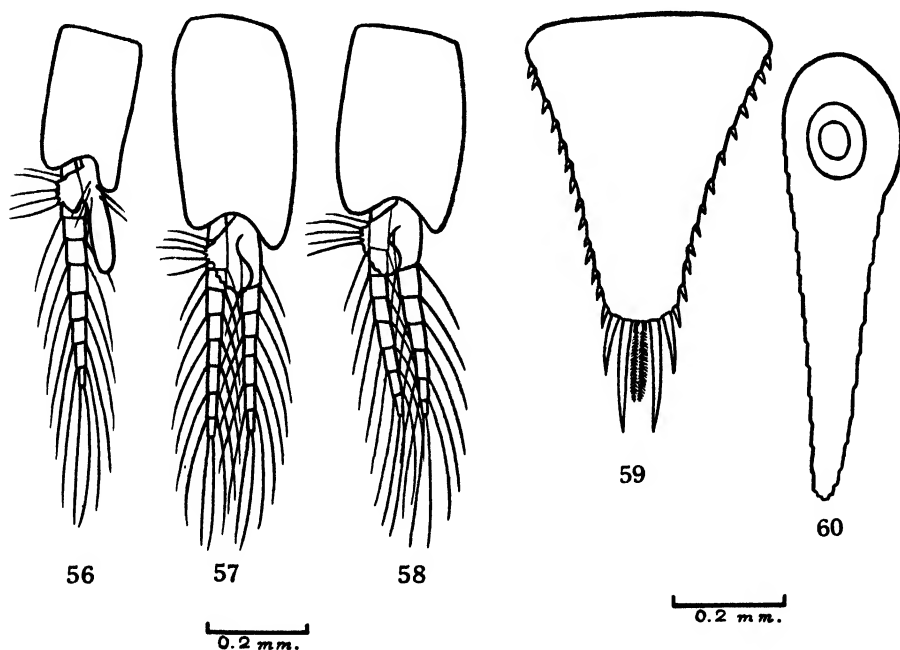
Figs. 56–60. *Hypererythrops zimmeri* n. sp.
Fig. 56. First pleopod of the male.
Fig. 57. Third pleopod of the male.
Fig. 58. Fourth pleopod of the male.
Fig. 59. Telson.
Fig. 60. Inner uropod.

First pleopod with 8-jointed exopod; endopod rudimentary, unjointed and about $1/2$ as long as the exopod.

Second to the fifth pleopods are similar in size and form; endopod 7-jointed, exopod 8-jointed and hardly longer than the endopod. Fourth pleopod not specialized as compared with the others and without spinous setae on the distal joints of the exopod.

In the pleopods of the male the setiferous lobes on the endopod swollen distally into a broad smooth branchial plate as in *H. spinifera*. The outer

margin of the branchial plate minutely serrulated, but devoid of setae. In the first pleopod the branchial plate considerably small.

Telson short, $^4/_5$ the length of the last abdominal somite, $1^1/_3$ times as long as broad at the base, long ob-trapezoidal with rounded angles; apex $^1/_4$ the width of the base, with 2 pairs of long stout spines, the inner pair $^3/_8$ the length of the telson, the outer pair $^3/_5$ the length of the inner, between the inner pair are a pair of extra small spines and a pair of plumose setae about $^3/_4$ as long as the inner pair; lateral margins armed throughout their length with 10–14 short regularly arranged spines.

Inner uropod about $1^1/_2$ times as long as the telson, without spines on the ventral inner margin.

Outer uropod about twice as long as the telson.

REMARKS. The present species agrees very well with Zimmer's description of *H. sp.*, collected from Amontatura, near Naples. In 1915, he described a species, which was clearly referable to the genus *Hypererythrops*. However, he obtained only a single male specimen too defective for a sufficient description, so he did not give it a name and only described it as *H. sp.*, though it seemed apparently to represent a new species.

Since Zimmer's description is very brief and incomplete and he did not give any illustrations of his species, I can not make full comparison of the present specimens with the Zimmer's. However, judging from the possession of the supra-ocular spines on the front margin of the carapace and the blunt spiniform process on the eyestalks, I think the present specimens may belong to the same species as that described by Zimmer. Hence, I here give the species the name, *H. zimmeri*, in honour of its original discoverer, Prof. C. Zimmer.

The present species, however, differs in one important feature from the description of Zimmer's specimen. In the present specimens the sterna of the first 4 abdominal somites are provided with simple papilliform process, while in Zimmer's single specimen the abdominal somites lack the sternal process. I suppose that the sternal process were overlooked by him or broken off in his specimen.

The presence of the supra-ocular spine on the frontal margin of the carapace and the blunt spiniform process on the eyestalks will serve to distinguish this species from all others of the genus.

DISTRIBUTION. Zimmer's species which, as above said, was collected from Amontatura near Naples, Italy, may be identical with the present one. No other previous record is known about the species. The record of occurrence of the species belonging to the present genus is the first in the waters of Japan and is interesting from view point of animal distribution, as it may indicate a very wide geographical range of the species.

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10. Polyclads collected in Idu, Japan

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(With 26 Text-figures and Plates XIV–XV)

The polyclad turbellarians dealt with in this work were collected in 1934–36 along the rocky shores in the neighborhood of the Mitsui Institute of Marine Biology at Susaki near Simoda, Siduoka Prefecture. In the present paper are reported the following 14 species, of which 5 appear to be new to science.
Order Polycladida.
    Suborder Acotylea
        A.   Section Craspedommata
           Family Discocelidae
              1. *Discocelis japonica* Yeri et Kaburaki
        B.   Section Schematommata
           Family Leptoplanidae
              2. *Stylochoplana amica* sp. nov.
              3. *Notoplana japonica* sp. nov.
              4. *Hoploplana villosa* (Lang)
           Family Displosolenidae
              5. *Pseudostylochus elongatus* sp. nov.
           Family Planoceridae
              6. *Planocera purpurea* Yeri et Kaburaki
              7. *Neoplanocera elongata* Yeri et Kaburaki
        C.   Section Emprosthommata
           Family Cestoplanidae
              8. *Cestoplana lactea* sp. nov.
              9. *Cestoplana rubrocincta* (Grube)
    Suborder Cotylea
           Family Pseudoceridae
              10. *Pseudoceros gratus* sp. nov.
              11. *Pseudoceros luteomarginata* Yeri et Kaburaki
           Family Eureleptidae
              12. *Cycloporus papillosus* (M. Sars)
           Family Prosthiostomidae
              13. *Prosthiostomum marmoratum* Yeri et Kaburaki
              14. *Prosthiostomum siphunculus* (Delle Chiaje)

1. *Discocelis japonica* Yeri et Kaburaki

(Fig. 1, 2)[1]

Discocelis japonica Yeri et Kaburaki, 1918, p. 3-5

This species is fairly common in early spring. It measures usually 40 mm in length and 20 mm in breadth. The ground color of the dorsal surface is light brown, darker in the central part, blotched all over with small darkish brown specks which become gradually smaller and fainter toward the body margin. The ventral surface is much paler than the dorsal without the specks. The younger specimen measuring 15–20 mm in length is uniformly light brown in color and totally lacking brownish specks on the dorsal side.

Fig. 1.   *Discocelis japonica*; eye-spots. ×35

On the external respect the present planarian resembles well *Discocelis tigrina* from Naples save a slight difference of the arrangement of cerebral eye-spots. In *japonica* the cerebral eye-spots are present in two elongate clusters on either side of the median line, each cluster is divided by the brain into an anterior and a posterior group, the former being more numerous and more crowded than the latter. In *tigrina* (Lang, 1884, p. 468) each cluster converges posteriorly to the median line and is not divided into two groups. Some differences are noticed on the internal structures between these two species. In *tigrina* the mouth occurs in the middle of the pharynx (Lang, 1884, Taf. 13, Fig. I), and in *japonica* it lies near the end of the pharynx. In *japonica* many muscular villus-like projections are subvertically disposed in the antrum masculinum from
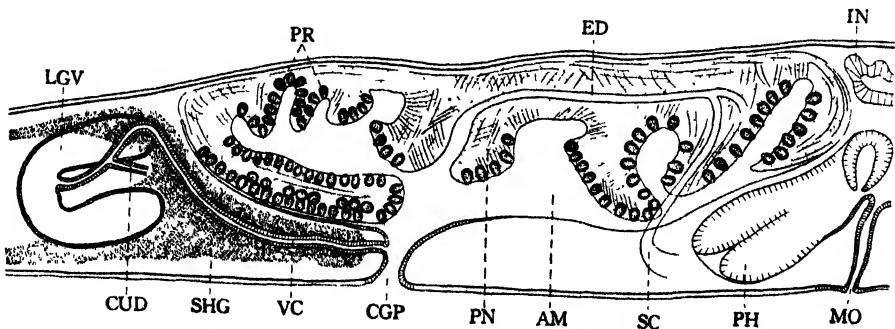
Fig. 2. *Discocelis japonica*; sagittal section through genital organs, schematized. ×20

its upper wall. Of these projections a large one lying in the middle is a penis which is pierced by the ejaculatory duct. Over the external surface of

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[1] Abbreviations in this and subsequent figures see p. 232.

the penis as well as the muscular projections there are a large number of glands of a prostatic character. In *tigrina* the antrum is ellipsoidal without such irregular projections, but it has a large muscular snail-foot-like penis in it (Lang, 1884, p. 246, Taf. 13, Figs. 8, 9; Taf. 30, Fig. 1).

Locality: Enoura in Prov. Suruga, Misaki, Sirahama in Prov. Awa, Susaki.

2. *Stylochoplana amica* sp. nov.

(Figs. 3, 4; Pl. XIV, 1-3, Pl. XV, 9.)

A single specimen of this species is placed at my disposal through the kindness of my friend Mr. S. Suzuki who found it on March, 1934 in an aquarium, in which were kept a number of limpets, *Patelloida schrenckii*.

In the living state the body is oval in shape and of a moderately firm consistency. The dimensions of the preserved specimen are as follows:

Total length	5.8 mm
Breadth at the widest part	3.5 mm
Tentacles from the anterior end	1.5 mm, 0.7 mm apart
Mouth	central
Genital pore from the posterior end	1.0 mm

The tentacles are rudimentary and situated at about one-fourth the body-length from the anterior extremity. At the base of each tentacle are arranged tentacular eye-spots, 12–14 in number. Cerebral eye-spots are smaller than the former and more numerous, scattering around the brain region on either side of the median line.

The color of the dorsal surface is vivid brownish green owing to the presence of the green pigments under the dermal musculature and of the brownish colored intestinal branches. Surrounding the colorless parts of pharynx and main genital organs exist darker brown specks. The ventral surface is paler.

The mouth is situated at about the center of the body and leads into the plicated pharynx. The main

Fig. 3. *Stylochoplana amica*; eye-spots. ×35

intestine is provided with a few lateral branches and bifurcates behind and in front of the pharynx. The intestinal epithelium consists of columnar cells containing a mass of eosinophile secretion granules. Minute black pigments are present on the dorsal side of the most part of the intestinal epithelium.

The epidermis is thicker on the dorsal side than on the ventral and contains minute rhabdites. The arrangement of the dermal musculature is quite in accord with that of other species of this genus. In the dermal musculature and in the parenchyma immediately beneath it exist a large number of green granules. This pigment is resistant against various chemicals, such as alcohol, cedar oil, xylol, therefore being well preserved in the preparation. The color of this animal is mostly due to these pigments.

The testes are chiefly scattered in the ventral half of the body. The

seminal canal, one on either side, proceeds forward from the level of the prostate to near the posterior end of the pharynx and abruptly turns backward to run toward the median line for a short distance to unite into a single duct. This passes into a tubular seminal vesicle with a thin muscular wall from its ventral side. The seminal vesicle continues posteriorly to the pear-shaped prostate gland with a strongly developed muscular coating which is pierced by the efferent ducts of the extracapsular prostate gland. The prostate narrows posteriorly into the ejaculatory duct which opens to the cylindrical antrum masculinum at the tip of an extremely small penis. The antrum is subvertically disposed and opens to the exterior at one-sixth the body-length from the hind end.
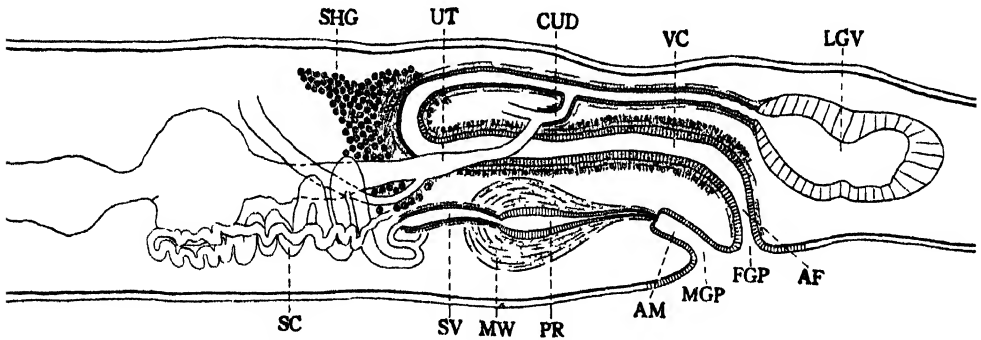
Fig. 4. *Stylochoplana amica;* sagittal section through genital organs, schematized. ×70

The female genital pore lies directly behind the male one, but is more separated from each other than those of *Stylochoplana pusilla.* The antrum femininum passes into the vagina which runs anteriorly over the male genital organs and at the level of the seminal vesicle turns abruptly backward and receiving the common uterine duct continues to the duct of the Lang's glandular vesicle. The Lang's vesicle is a large four lobed body. The vagina is a wide canal with a fairly developed muscular wall and surrounded of a large amount of minute granular shell secretion which is chiefly conveyed from the spherical gland cells massed closely together in front of the main genital organs. The common uterine duct soon divides into two. The outer pair are very narrow and terminate at the posterior end of the pharynx. The inner pair, provided with numerous side pockets, run to near the brain region and contain a mass of ova and spermatozoa in its entire length as seldom seen in *Polyposthia similis* (Bock, 1913) and in *Discoplana takewakii* (Kato, 1935b).

This species may belong to the group A (Bock, 1913) of the genus *Stylochoplana* and is clearly distinguished from known species by its color markings caused by green pigments and by its tubular seminal vesicle as well as the characteristic features of the uterine duct.

3. *Notoplana japonica* sp. nov.

(Figs. 5, 6; Pl. XIV, 6, 7.)

A number of specimens of this new species were collected from the under-surface of stones embedded rather deeply in the sand at the low tide-mark during spring and summer.

The animal is of elongate shape, rounded at the anterior end and bluntly pointed at the posterior extremity. The large specimen measures 30 mm long by 6 mm broad at the widest part.

The color of the dorsal surface is milky white with a faint touch of brown and is pinkish around the tentacles and along the median line. The uterus is discernible as milky white streaks on either side of the pharyngeal sheath. The body margin is colorless. The ventral side is paler in color.

A pair of highly reduced tentacles are situated at the level between one-fifth and one-sixth the body-length from the anterior end, but they are hardly visible in the preserved specimen. At the base of the tentacles are clustered the eye-spots, about 10 in number. Cerebral eye-spots are scattered on either side of the median line. The latter are larger and more numerous than the former.

The mouth lies at the posterior limit of the three-sevenths of the body from the anterior end and leads into the plicated pharynx. The main intestine is provided with about 12 pairs of lateral branches.

Fig. 5. *Notoplana japonica;* eye-spots. ×55

The seminal canal, one on either side, proceeds backward skirting the pharyngeal chamber to near the male genital pore and here turns abruptly anteromediad to open separately into the moderately wide seminal vesicle. The latter is a bean-shaped body with a thick muscular wall. The vesicle narrows posterodorsally to pass into a narrow ejaculatory duct which piercing the prostate gland opens at the tip of the penis. The prostate gland is a pear-shaped organ with well developed muscular coating and consists of a few tubular glands which surround the ejaculatory duct and open into the latter at the base of the penis. The penis is a large muscular process provided with no chitinous stylet and is disposed vertically in the narrow tubular penis sheath. The latter is highly protruded from the basal wall of the cylindrical antrum masculinum which opens externally at about the hind end of four-sevenths the body-length.

The female genital pore lies immediately behind the male pore. The antrum femininum passes upwardly into the shell gland duct which curves down posteriad and after receiving the common uterine duct continues to the duct of Lang's glandular vesicle. This duct assumes a bead-like appearance. The Lang's vesicle is an elongated swollen sac and contains a mass of degenerated

Fig. 6. *Notoplana japonica*; sagittal section through genital organs, schematized. ×65

spermatozoa. The common uterine duct soon divides into two uteri, each of which skirting the pharyngeal chamber, joins together in the median line immediately in front of the pharynx.

Bock (1913) classified *Notoplana*-species into three groups: A. *N. evansi*-group, B. *N. atomata*-group, C. *N. alcinoi*-group. The present species belongs to the group B than C from its peculiarities of the penis and its sheath. This planarian can readily be distinguished from other Japanese species, *N. humilis* and *delicata*, by the arrangement of the eye-spots and the color markings, not even going into its internal structures.

4. *Hoploplana villosa* (Lang)

(Figs. 7, 8; Pl. XV, 10.)

Planocera villosa Lang, 1884, p. 441–442.
Hoploplana villosa Bock, 1913, p. 225.

Two specimens which can be referred to *Hoploplana villosa* of Naples were obtained on May 22, 1936. The body is firm and oval in shape. The specimens measure 10 mm by 6 mm, 4 mm by 2.5 mm in length and width respectively.

The color of the dorsal surface is light brownish yellow with dense reticulation of yellowish and blackish pigment. Moreover, black spots are scattered here and there. Body margin is colorless and translucent. All over the dorsal surface are present numerous small, slenderly conical papillae, the inner side of which is of reddish yellow in color. The pharyngeal region is milky white and the intestinal branches brownish yellow. The ventral surface is milky white.

At the hind limit of the anterior third of the body are situated a pair of long conical tentacles, at the base of which lie the tentacular eye-spots, 20–25 in number. Between the tentacles occurs the brain and in front of this are scattered small number of cerebral eye-spots on either side of the median line.

The epidermis is of almost equal thickness on both the dorsal and ventral

sides. It consists of columnar ciliated cells which contain numerous rhabdites. All over the dorsal surface occur numerous papillae, the existence of which is a characteristic feature of this species. On the structural respect these papillae are of purely epithelial origin and widely different from those of *Thysanozoon*, *Cycloporus* and others. The epidermis on the papilla is thinner than in the other part and contains no rhabdite. The inner side is occupied with an elongate vesicle, the proximal part of which slightly enlarges and ends blindly in the basal membrane. In the vesicle are seen a few muscle fibres

Fig. 7. *Hoploplana villosa*; eye-spots. ×55

and much basophilous filaments. The latter and rhabdites are noticed to be conveyed through the basement membrane by the ducts of the dermal glands. The basement membrane is thicker on the dorsal side than on the ventral. The musculature is poorly developed.

The mouth occurs at about the middle of the body and leads into the plicated pharynx which occupies the central part of the body.

The seminal canal, one on each side, runs backward along the ventral side from the level of the mouth and near the hind end of the pharynx dilates to make a large false seminal vesicle with a rather thick muscular coating consisting of circular muscle fibres. From the posterodorsal end of this vesicle is sent off a duct which runs for a short distance to the median line and joins with the duct from the other side to make a common ejaculatory duct. Taking a slight tortuous course the ejaculatory duct passes ventrad into a small prostate vesicle which opens to the antrum masculinum with the chitinous penis, the latter is a curved, pointed stylet and subvertically disposed in the antrum. The prostate vesicle is so small that it is noticed only as a slightly distended part of the ejaculatory duct lined with the special secreting epithelium. The antrum masculinum is a long cylindrical shape and directed posteroventrally to open outside at about the hind limit of the middle third of the body. Both the antrum and the prostate gland are coated with a thick musculature, along the outside of which are scattered numerous unicellular glands. The secretion granules from these glands are eosinophilous. They are discharged through the muscular wall into the prostate as well as into the whole antrum masculinum. Such an arrangement of the extracapsular glands has not yet been seen in any *Hoploplana*, but the similar structure was observed in several *Discoplana* species which have no prostate gland.

Running along either side of the pharynx, the uteri, highly enlarged with

ova, join into an egg-canal at the median line near the hind portion of the male genital organs. The egg-canal takes a semicircular course toward anteriad to continue into a shell-gland duct. This duct, surrounded by the shell glands
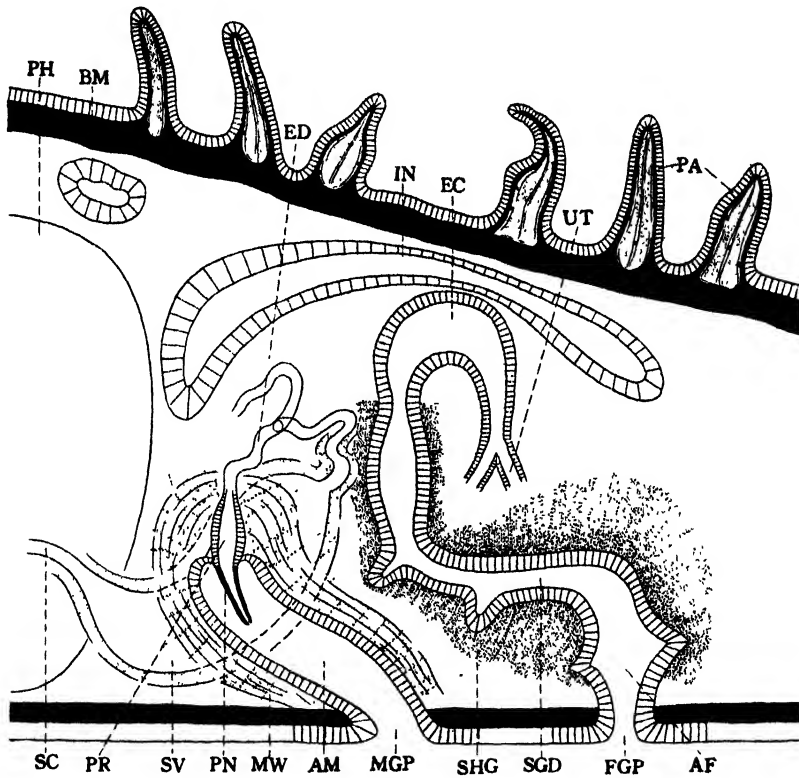
Fig. 8. *Hoploplana villosa;* sagittal section through genital organs, schematized. ×140

along the whole length, proceeds posteriad for a short distance and meets the wide antrum femininum with a few outbulgings. The antrum opens to the exterior immediately behind the male genital pore.

Localities: Naples and Nisida, Susaki.

5. *Pseudostylochus elongatus* sp. nov.

(Figs. 9, 10; Pl. XIV, 4, 5.)

A large number of this planarian were obtained near the low tide-mark in the spring, 1935 and 1936. The body is elongated, Leptoplanid-habitus, with a broadly rounded anterior and a bluntly pointed posterior extremity. The length of the body is three times as long as the breadth in the living state and the large specimen measures 25 mm long by 8 mm broad at the level of the brain.

The ground color is a light tan on which are found minute pigment spots of dark brown. Pigment is lacking on the ventral side. The pharyngeal

region and the main intestine appear to be milky white and a radially branched intestinal system is well discernible by its brownish color.

A pair of small tentacles lie at the posterior limit of the anterior sixth of the body, at the base of each tentacle is present a cluster of distinct eye-spots. Cerebral eye-spots are numerous and irregularly scattered on both sides of the median line.

The dermal musculature is poorly developed. The dorsal side consists of an outer longitudinal and an inner circular thin muscle layer. The ventral side is composed of an outer longitudinal and two inner diagonal layers, and in between runs a feeble transverse muscle layer.

The mouth is situated at about the center of the body and passes into the plicated pharynx. The main intestine runs along the median line and is provided with about 10 pairs of lateral branches.

The seminal canal, one on each side of the pharyngeal chamber, proceeds backward to near the male genital opening

Fig. 9. *Pseudostylochus elongatus:* eye-spots. ×35

converging mediad and joins into a single duct, which passes from the ventral side into a seminal vesicle with a muscular wall. The seminal vesicle tapers posteriorly into a slender ejaculatory duct. After receiving the duct of the prostate gland at the base of the penis, the ejaculatory duct makes its way at the tip of the tubular penis. It is disposed subvertically in the penis sheath which opens to the exterior through a narrow antrum at the hind end of three-fifth of the body.

Fig. 10. *Pseudostylochus elongatus;* sagittal section through genital organs, schematized. ×35

The female genital pore lies slightly behind the male one. The antrum femininum passes anterodorsally into the vagina with a muscular wall, which turns posteriorly and soon receives a common uterine duct to continue into

the duct of Lang's glandular vesicle, a large laterally compressed organ containing a mass of degenerated spermatozoa. Surrounding the vagina are accumulated an enormous amount of shell gland secretions which are conveyed from the shell glands scattering under the dermal musculature. Each uterus runs to the anterior end of the pharynx.

The genus *Pseudostylochus* was instituted by Yeri and Kaburaki (1918) in the family Diplosolenidae and has four Japanese species: *P. takeshitai, fulvus, obscurus* and *fuscoviridis*. The present species bears a certain resemblance to *takeshitai*, but differs markedly from this in a more elongate shape of body, the arrangement of eye-spots and in some features of the male genital organs, especially in the lack of connective tissue pad at the tip of the penis.

6. *Planocera purpurea* Yeri et Kaburaki

Planocera purpurea Yeri et Kaburaki, 1918, p. 22–23.

5 specimens referable to *Planocera purpurea* were collected on May and June, 1936. The largest specimen measures 25 mm long by 18 mm broad. Internally as well as externally this species closely resembles *P. reticulata* save the coloration of the dorsal surface, which is uniformly dark purplish in the former. Further studies is needed to separate these two species.

Localities: Misaki, Sirahama and Susaki.

7. *Neoplanocera elongata* Yeri et Kaburaki

(Figs. 11–15; Pl. XIV, 8.)

Neoplanocera elongata Yeri et Kaburaki, 1918, p. 17–19.

A single specimen referable to *Neoplanocera elongata* was obtained on July 10, 1934 at Susaki near the low tide-mark. To Yeri and Kaburaki's description of this interesting Planocerid, I will make here some additions and emendations. The measurements of the present specimen in life are as follows:

Total length	50 mm
Total breadth	10 mm
Tentacular eye-spots from the anterior end	7 mm, 0.6 mm apart
Mouth from the anterior end	17 mm
Length of pharyngeal sheath	7.5 mm
Male and female genital pore	central
Breadth of the marginal reticulated epithelium	0.7 mm

The external features of the present specimen are quite in accord with the original descriptions.

The epidermis consists of cylindrical ciliated cells which contain many rhabdites. The dorsal epidermis is 0.16 mm in thickness and the ventral 0.13 mm along the median line. Along the periphery of the entire dorsal surface a narrow zone of reticulated epithelium is distinctly noticeable with a

lens in both the living and preserved state. This reticulated zone consists of two sorts of cells. The principal cells are more cylindrical than the others, 0.21 mm in thickness and each contains a nucleus at its base and a large amount of rhabdites which are conveyed from the gland scattered in the parenchyma under the dorsal dermal musculature. A number of these principal cells are surrounded in a polygonal shape with secreting cells arranged regularly in a row. The secreting cell is columnar and filled with basophilous granules. The reticulated appearance of marginal epithelium is due to the furrows made by the adjoining lines of secretory cells surrounding the groups of the principal cells.

The dermal musculature is highly developed compared with *Planocera* and *Paraplanocera*. On the dorsal side from the outer to the inner side are five layers: an extremely thin transverse muscle layer immediately beneath the basement menbrane, a thick longitudinal layer, two diagonal muscle layers crossing at right angles and an innermost transverse muscle layer. On the ventral side a transverse muscle layer, a well developed longitudinal muscle layer, a thin diagonal, two circular and a most developed longitudinal muscle layer.

"Seminal canals, running backward along the sides of pharyngeal pocket, form on each side a slightly convoluted widening of the nature of accessory seminal vesicles. Posteriorly they join into a single median duct at a point far in front of the male aperture. The median duct, after running anteriorly for a short distance, enters the seminal vesicle at its anterior end. The seminal vesicle is an elongate-ovoid muscular organ, imbedded in the parenchyma of the dorsal parts of body. After emerging from this at the opposite end, the duct directly enters the muscular wall of the somewhat ellipsoid cirrus and opens at the tip of a small conical and posteriorly directed process projecting into the cirrus cavity. — " (Yeri and Kaburaki)

In the present specimen, near the hind end of the pharynx the seminal canal forms a convoluted widening which passes posteriorly into a very narrow duct proceeding mediad and leads, instead of " a single median duct", into the true seminal vesicle from the posterior end at the same point. This seminal vesicle is an elongate body with a comparatively thin muscular wall
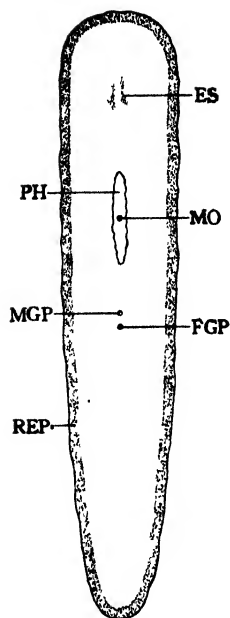
Fig. 11. *Neoplanocera elongata.* ×1.6

Fig. 12. *Neoplanocera elongata;* eye-spots. ×35
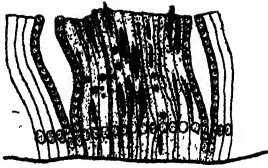
Fig. 13. *Neoplanocera elongata*; transverse section through a portion of marginal reticulated epithelium. ×380

and an outer nucleated zone, and distended with a mass of spermatozoa. Curving dorsad the anterior end narrows into a short ejaculatory duct which thrusts a little into the prostate gland. Provided with a moderately thick muscular wall the prostate gland is lined with a tall glandular epithelium and contains in its cavity a large mass of eosinophilous secretion. A number of the extracapsular glands are obviously noticeable outside the muscle wall. The posterior part of the prostate gradually narrows to form a duct to
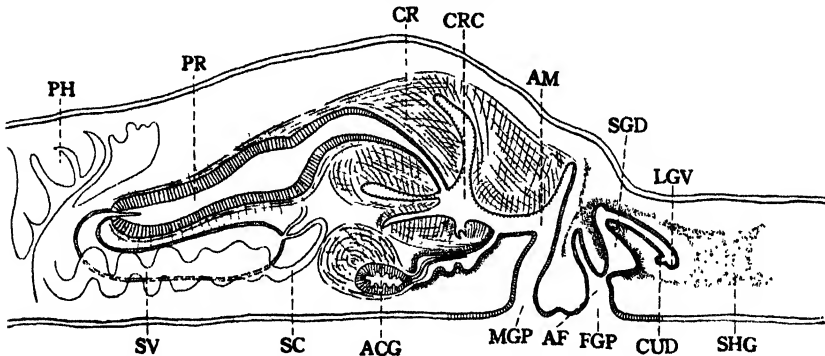
Fig. 14. *Neoplanocera elongata*; sagittal section through genital organs, schematized. ×18

open into the cirrus cavity at the tip of the penis-like conical protrusion in the cirrus cavity. The surface of the cirrus cavity and the penial protrusion are beset with stiff chitinous bristles peculiar to Planoceridae. The cirrus cavity forms some irregular outbulgings and leads to the exterior through the tubular antrum masculinum at a median point slightly behind the pharyngeal sac. On the anterior side of the cirrus cavity near the antrum opens a pe-
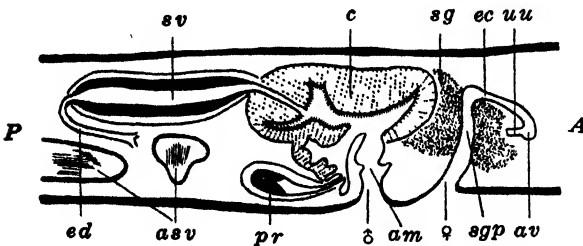
Fig. 15. *Neoplanocera elongata*; sagittal section through genital organs. (after Yeri and Kaburaki)

A anterior, *am* antrum masculinum, *asv* accessory seminal vesicle, *av* accessory vesicle, *c* cirrus, *ec* egg-canal, *ed* ejaculatory duct, *P* posterior, *pr* prostate, *sg* shell gland, *sgp* shell-gland passage, *uu* unpaired uterine duct, ♂ male genital aperture, ♀ female genital aperture.

culiar gland on the median line which was stated by Yeri and Kaburaki as the prostate gland. "The prostate is a pyriform muscular organ lying beneath the cirrus and opens behind into a ventral outbulging of the floor of cirrus cavity". But on closer examination it turned out to be a more complex gland entirely different from the prostate. This gland is composed of two

parts, a tubular invagination of the cirrus cavity and an ovoid gland situated at the end of the invaginated canal. The tubular part is lined with cylindrical cells and surrounding it is found eosinophilous secretion. The ovoid gland is covered with a strongly developed muscular wall and lined with cylindrical cells. The hind end of this vesicle passes to a slender muscular projection, through which by a narrow duct the gland makes its way into the tubular part just mentioned. The secretion of the ovoid vesicle is for the most part of basophilic nature and is conveyed from the unicellular glands scattering in large numbers in the muscular wall. At the outlet of the vesicle are observed also the fine eosinophilous granules originated from the extracapsular glands. Judging from the anatomical details and the unusual position in the genital system, this complex gland seems to be an organ homologous with the accessory gland of the antrum masculinum in *Paraplanocera*.

"The uteri, after running along the sides of the pharyngeal pocket, extend further backward and join together into a short common uterine duct, which joins the median egg-canal at its posterior end. The accessory vesicle is exceedingly small and rudimentary. The egg-canal pursues a somewhat tortuous course obliquely forward and upward for a short distance, and then making a sharp downward bend, expands into the vaginal canal surrounded by numerous shell glands. The vaginal canal opens to the exterior at a position closely behind the male aperture" (Yeri and Kaburaki).

Neoplanocera is allied to *Disparoplana* in the lack of the tentacles and resembles *Stylochoplana papillifera* in the possession of the prostate gland of Leptoplanid-type. However, it differs markedly from other genera in various points especially in having a gland connected to the cirrus cavity. The diagnosis of *Neoplanocera* is as follows: "Planoceridae with elongate body, without tentacles. With tentacular and cerebral eye-spots. With true seminal vesicle and large intercalated prostate gland. Cirrus with spines of Planocerid-type. Without penis. Lang's glandular vesicle rudimentary. With accessory gland of male genital organs".

8. *Cestoplana lactea* sp. nov.

(Figs. 16, 17; Pl. XV, 1-6.)

This new species is represented by a single specimen obtained near the low tide-mark on July 20, 1935. The body is of an elongated band-like shape, being uniformly broad for the most part of the body with a triangular anterior end and a bluntly pointed posterior extremity. The body is very contractile and measures 60 mm long by 4 mm broad in the fully extended state. The ground color of the body is milky white without any markings. The brain lies in the median line at the base of the triangular anterior end. Numerous minute eye-spots occur in two indistinct clusters in the frontal part, chiefly in front of the level of the brain and are more densely scattered near the periphery and along the median line. The pharynx and the genital organs are disposed near the posterior end of the body.

The mouth lies near the hind border of the short plicated pharynx. The main trunk of the intestine runs along the median line and almost on the entire body-length giving off numerous lateral branches, which ramify repeatedly but do not anastomose.
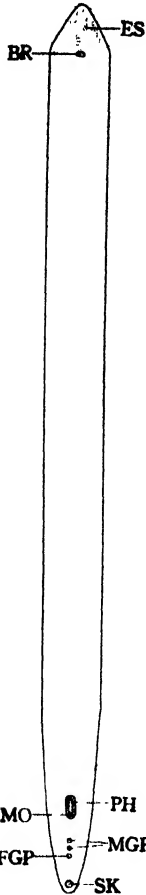
The epidermis is much thicker on the dorsal than on the ventral side and consists of tall columnar ciliated cells containing a large number of spindle-shaped rhabdites. The dermal musculature is well developed. The dorsal musculature is composed of three layers, outer longitudinal, middle diagonal and inner transverse. The ventral musculature is strongly developed than the dorsal and is made up of three layers, outer thin longitudinal, middle transverse inner thick longitudinal muscle fibres which are enclosed in follicles.

In the parenchyma immediately beneath epidermis are numerous sporozoan cysts like those observed in *C. rubrocincta* by Lang.

The sucker measures about $280\,\mu$ in diameter, and is circular in shape. It is made up of columnar cells taller than the epidermal cells. They contain eosinophilous granules which are conveyed through the basement membrane from the numerous unicellular glands embedded in the parenchyma. Surrounding the sucker the musculature is well developed.

Three apertures open one behind another in the median line between the mouth and the posterior sucker. The foremost and the middle aperture are the male genital openings and the hindmost is the female. The arrangement of the genital pores is somewhat like *Bergendalia diversa* (Yeri et Kaburaki, 1918). Two pairs of seminal canals distended with sperms run from the anterior part to near the hind end of the body. Each pair turn anteriad to run for a short distance and pass into a narrow duct which proceeds to the middle and separately opens into a large seminal vesicle at its ventral end. The seminal vesicle is an elongate ovoid body with a thick muscular wall provided with an outer nucleated zone and lined with a flat epithelium. In its cavity are found a mass of spermatozoa. Emerging from the other end of the vesicle, a narrow ejaculatory duct pursues a sinuous course to meet an ovoid prostate gland. The prostate is lined with a thick glandular epithelium and coated with a muscular wall through which pierce numerous efferent ducts of extracapsular glands. The prostate gives off anteriad a narrow duct which immediately merges into the base of penis. The penis is disposed subvertically in the narrow sheath which is directed slightly

Fig. 16. *Cestoplana lactea.* × 2

anteriad, the feature characteristic of *Cestoplana*. The duplicate male genital organs are equally functional judging from the presence of a mass of spermatozoa in each seminal vesicle and seminal canals. Both the testes and ovaries scatter chiefly on the dorsal part of the body mingling with each other.
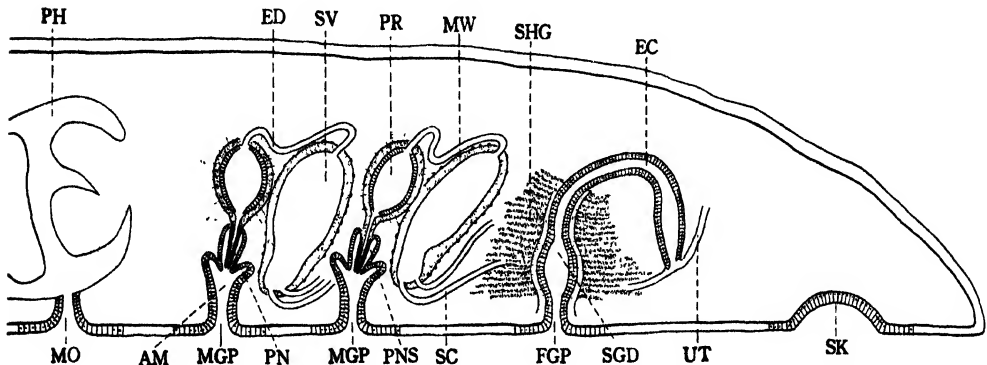
Fig. 17. *Cestoplana lactea;* sagittal section through genital organs, schematized. ×70

The female genital pore passes directly into a wide shell gland canal with a rather thick muscular coating, the inner wall of which consists of columnar epithelial cells containing an elongate nucleus at each base. The canal curves posterodorsally and soon bends ventrad to continue into the egg-canal which receives at its end a pair of the uterus from either side. The Lang's glandular vesicle is lacking. The uterus, distended with ova, goes to the lateral part of the body and turns forward to proceed toward the anterior portion of the body. Surrounding the shell gland passage is a large mass of shell secretion.

So far as I am aware, 7 species of *Cestoplana* have been recorded *i. e.*, *rubrocincta* from the Mediterranean Sea, *faraglionensis* from Naples, *ceylanica* from Ceylon, *filiformis* from Zanzibar, *australis* from South East Australia, *polypora* from Koseir in the Red Sea and *raffaelei* from Naples. The present species can easily be distinguished from all these species in the possession of the duplicate male genital organs. In the distribution of the eye-spots this worm is related to *ceylanica* (Laidlaw, 1902), however Laidlaw's description is too meagre to allow an exact identification of the species. "*Cestoplana ceylanica* sp. n. Very closely allied to *C. rubrocincta*. Length about 65 mm, breadth 9 mm anterior end of the body pointed. Color (in the spirit specimen) dull gray with traces of a darker margin. Eye-spots (see Fig. 72) much as in *C. rubrocincta*, but the hinder margin of the eye-bearing area is straighter" (Laidlaw).

9. *Cestoplana rubrocincta* (Grube)

(Figs. 18, 19; Pl. XV, 7, 8.)

Orthostomum rubrocinctum Grube, 1840, p. 56.

Fig. 18. *Cestoplana rubrocincta.* ×5

Tricelis fasciatus Quatrefages, 1845, p. 131.
Cestoplana rubrocincta (Grube) Lang, 1884, p. 516–520.
Cestoplana filiformis Laidlaw, 1903, p. 110–111.
Cestoplana australis Haswell, 1907, p. 479–480.

A single specimen referable to this species was collected from under a stone in tide-pool in April, 1935. It measures 20 mm long by 2 mm broad in the fully extended condition. The anterior end of the body is slightly constricted as shown in Fig. 18 and the posterior end is bluntly pointed. The ground color of the dorsal surface is milky white with a faint touch of yellow and the body margin is colorless. Along the whole dorsal margin there is a beautiful reddish orange striation, which is interrupted at the anterior constriction. A more slender striation of the same color is found along the median line from the anterior end of the body to near the hind end. In the arrangement of the colored striations in the anterior part of the body the present specimen bears a close resemblance to a large specimen of *C. rubrocincta* from Naples observed by Lang, and it also is closely allied to both *Tricelis fasciatus* of Quatrefages (1845) and *C. australis* of Haswell (1907). The ventral surface is milky white without any marking.

A large number of the minute eye-spots are scattered near the anterior end of the body, mostly in front of the brain but some also behind it. A sucker is present at the posterior extremity of the body. No parasitic sporozoan is observed.
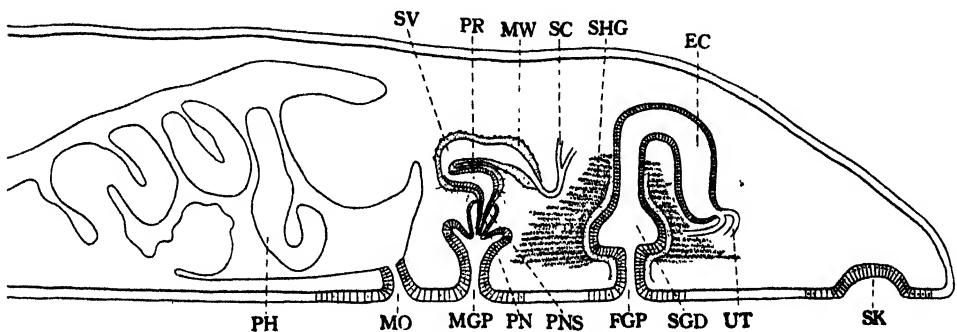
Fig. 19. *Cestoplana rubrocincta;* sagittal section through genital organs, schematized. ×75

A slight difference is recognized in the shape of the anterior body end of the present and the Mediterranean specimens, that of the latter ending bluntly without constriction.

Laidlaw (1903) established a new species *C. filiformis* basing on a single immature specimen with the head damaged, stating: "Evidently closely allied to the Mediterranean *C. rubrocincta*, but, I think, sufficiently distinguished by its much smaller size and yellow instead of red stripes". Haswell also described *C. australis*. He says: "The only external difference which I can detect between the Australian and European species is that in the former the three longitudinal bands completely fuse, whereas in the latter they do not". Judging from these descriptions, I consider both *filiformis* and *australis* are varieties of *rubrocincta*.

The occurrence of the sucker in *Cestoplana* was first observed by Lang in *rubrocincta* and *faraglionensis*. Since Lang, none of authors have mentioned the presence of the sucker in *Cestoplana*. The sucker observed in *Cestoplana* is quite different from those found in such acotylic polyclads as *Leptoplana tremellaris* (Keferstein, 1868), *Leptoplana vitrea* (Lang, 1884) and others. Therefore, so far as three species, *rubrocincta*, *faraglionensis* and *lactea* are concerned, *Cestoplana* may reasonably come under Cotylea.

10. *Pseudoceros gratus* sp. nov.

(Figs. 20–22)

A single specimen of this splendid *Pseudoceros* was placed at my disposal through the kindness of my friend Mr. J. Ishida who found it on the stone in the tidal zone in front of the Institute on March 25, 1934.

In the living state, the body is of a leaf-like shape with a strongly frilled margin and measures 50 mm long by 25 mm broad at the widest part.

The dorsal side is milky white and is marked with three black bands, a median and a pair of lateral along the entire body length. The two lateral bands are continuous with each other at the posterior end of the body. In addition to these bands, the body is completely bordered by a narrow black stripe, gradually shading inward to milky white. The ventral side is also milky white.

A large number of the eye-spots are distributed as usual on the tentacular folds in two clusters of a triangular shape. In a clear space at the base of the tentacular folds are the cerebral eye-spots indistinctly divided into two groups.

A sucker is situated at the center of the body. The mouth lies closely behind the brain at about the anterior sixth of the body. The intestinal branches form a network. The epidermis is composed of columnar cells, containing numerous rhabdites and black pigments just mentioned.

Fig. 20. *Pseudoceros gratus*; slightly enlarged.

This planarian has a paired male genital organs closely situated on both
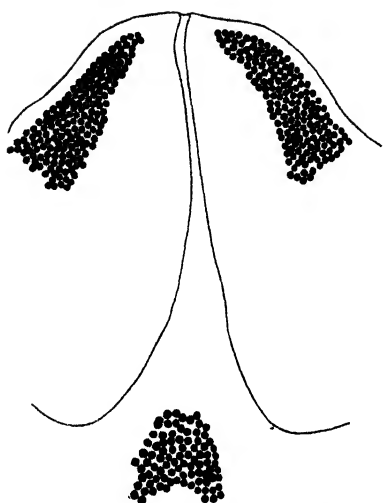
Fig. 21. *Pseudoceros gratus;*
eye-spots. ×35

sides of the median line as observed in several *Pseudoceros* species such as *P. bedfordi, nigromarginata* and *luteomarginata.* The seminal canal, one on either side, proceeds forward to the level slightly behind the female genital pore, and passes anteriorly into the wide seminal vesicle of a crescent shape with a well developed muscular wall. The seminal vesicle is narrowed ventrally to form a slender ejaculatory duct which runs pursuing anteriorly a sinuous course and after receiving the duct of the prostate gland at the base of the penis, opens at the tip of the latter. The small pyriform prostate lies just in front of the penis and has a thick muscular wall which is pierced with numerous efferent ducts of the extracapsular gland. The penis is a chitinous stylet of a wavy outline and sub-
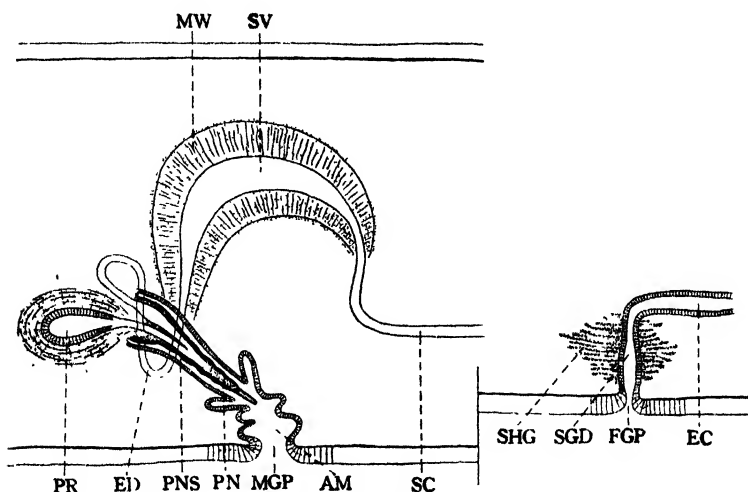
Fig. 22. *Pseudoceros gratus;* sagittal section through genital organs, schematized. ×55

vertically disposed in the penis sheath. The antrum masculinum forms an oblique anteriorly directed annular outbulging before it opens externally at the hind limit of one-third of the body.

A female genital pore lies closely behind the male pore. The arrangement of the female genital organs is much similar to that found in other species of this genus.

The present species differs distinctly from all other members of *Pseudo-*

ceros in the peculiar color markings as well as in the anatomical details of the male genital organs.

11. *Pseudoceros luteomarginata* Yeri et Kaburaki

Pseudoceros luteomarginata Yeri et Kaburaki, 1918, p. 37–39.

Two specimens of this species were collected on June 28, 1934. It measures 50 mm in length and 25 mm in breadth. The dorsal surface is velvet black and bordered all round by a colorless marginal band, in which a small number of orange specks are present. The color of the marginal band in these specimens is somewhat different from that of the specimens from Misaki.

Localities: Misaki, Susaki.

12. *Cycloporus papillosus* (M. Sars)

(Figs. 23, 24)

Cycloporus papillosus Lang, 1884, p. 568–571; Yeri et Kaburaki, 1918, p. 40–41.

Numerous specimens identical with the Misaki form of *Cycloporus papillosus* were found in summer on compound ascidians between tide-marks. The specimens are closely allied to *C. papillosus* var. *levigatus* (Lang, 1884) from Europe in the total absence of dorsal papillae. Although the arrangement of cerebral eye-spots is widely different from each other, the internal
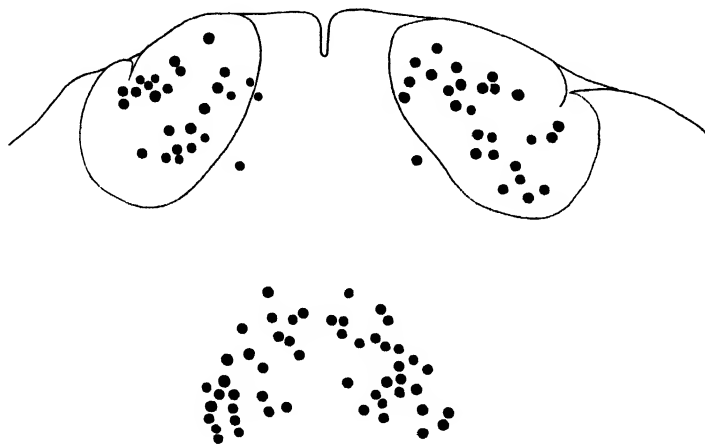
Fig. 23. *Cycloporus papillosus;* eye-spots. ×55

structure is quite similar in both forms.

Cycloporus variegatus (Kato, 1934b) from Susaki is not only distinguished from *papillosus* in such external features as the color marking of the body and the shape of the tentacular flaps, but also in some internal structures. In *variegatus*, there is a narrow canal connecting the intestinal branch and the

terminal vesicle, while in *papillosus* the intestinal branch directly continues to the terminal vesicle.   In *papillosus* two genital pores are closely approximated and the seminal vesicle lies above the antrum femininum or shell gland duct,
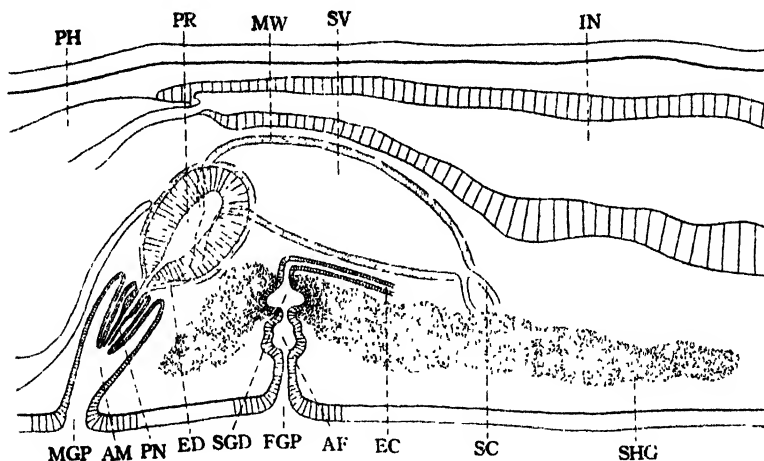
Fig. 24. *Cycloporus papillosus;* sagittal section through genital organs, schematized. ×70

while in *variegatus* two genital pores are widely separated from each other and the seminal vesicle lies on the ventral side between two genital pores.
Localities: Misaki, Susaki.

13. *Prosthiostomum marmoratum* Yeri et Kaburaki

Prosthiostomum marmoratum Yeri et Kaburaki, 1918, p. 43–44.

Two specimens were obtained on June 28, 1935.
Localities: Sirahama and Susaki.

14. *Prosthiostomum siphunculus* (Delle Chiaje)

Prosthiostomum siphunculus Lang, 1884, p. 595–601; Meixner, 1907, p. 481; Yeri et Kaburaki, 1918, p. 41; Palombi, 1936, p. 31–32.

This species widely distributed in Europe is also fairly common in summer at Susaki.   It is easily recognized by its elongate shape of body and the coloration as well as the distribution of the eye-spots.
Localities: Matuwa, Misaki, Sirahama and Susaki.

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EXPLANATION OF PLATES

PLATE XIV

1. *Stylochoplana amica* sp. nov. ×6.5
2. Same, longitudinal section through genital organs. ×70
3. Same, longitudinal section through tentacle. ×70
4. *Pseudostylochus elongatus* sp. nov. ×1
5. Same, longitudinal section through genital organs. ×45
6. *Notoplana japonica* sp. nov. ×1
7. Same, longitudinal section through genital organs. ×70
8. *Neoplanocera elongata*, longitudinal section through genital organs. ×26

PLATE XV

1. *Cestoplana lactea* sp. nov., anterior end of body. ×12
2. Same, longitudinal section through posterior end of body showing the sucker. ×130
3. Same, tangential section through dorsal part of body showing two cysts of parasitic
       sporozoan. ×130
4–6. Same, tangential section through genital organs. ×60
7. *Cestoplana rubrocincta*, anterior end of body. ×12
8. Same, longitudinal section through posterior end of body. ×60
9. *Stylochoplana amica*, part of a longitudinal section showing the uterus containing eggs
       and sperm. ×70
10. *Hoploplana villosa.* ×12

ABBREVIATIONS

ACG accessory gland; AF antrum femininum; AM antrum masculinum; BM basement
membrane; BR brain; CE cerebral eye-spot; CGP common genital pore; CR
cirrus; CRC cirrus cavity; CSP cyst of sporozoan; CUD common uterine duct;
EC egg-canal; ED ejaculatory duct; EG egg; ES eye-spot; FGP female genital
pore; IN intestine; LGV Lang's glandular vesicle; MGP male genital pore; MO
mouth; MW muscular wall; PA papilla; PH pharynx; PN penis; PNS penis
sheath; PR prostate gland; REP reticulated epithelium; SC seminal canal; SGD
shell gland duct; SHG shell gland; SK sucker; SP sperm; SV seminal vesicle;
TE tentacular eye-spot; TN tentacle; VC vaginal canal; UT uterus; ♂ male
genital pore; ♀ female genital pore.

1

2

LGV   VC   ♂   PR   SV   SHG

VC   SHG   PR

5

♀   PN   SV

3

SGD   CR   PR

4

6

8

LGV   ♀   ♂   CRC   ACG   SV

SGD   PR

7

LGV   SHG ♀   PN   SC   SV
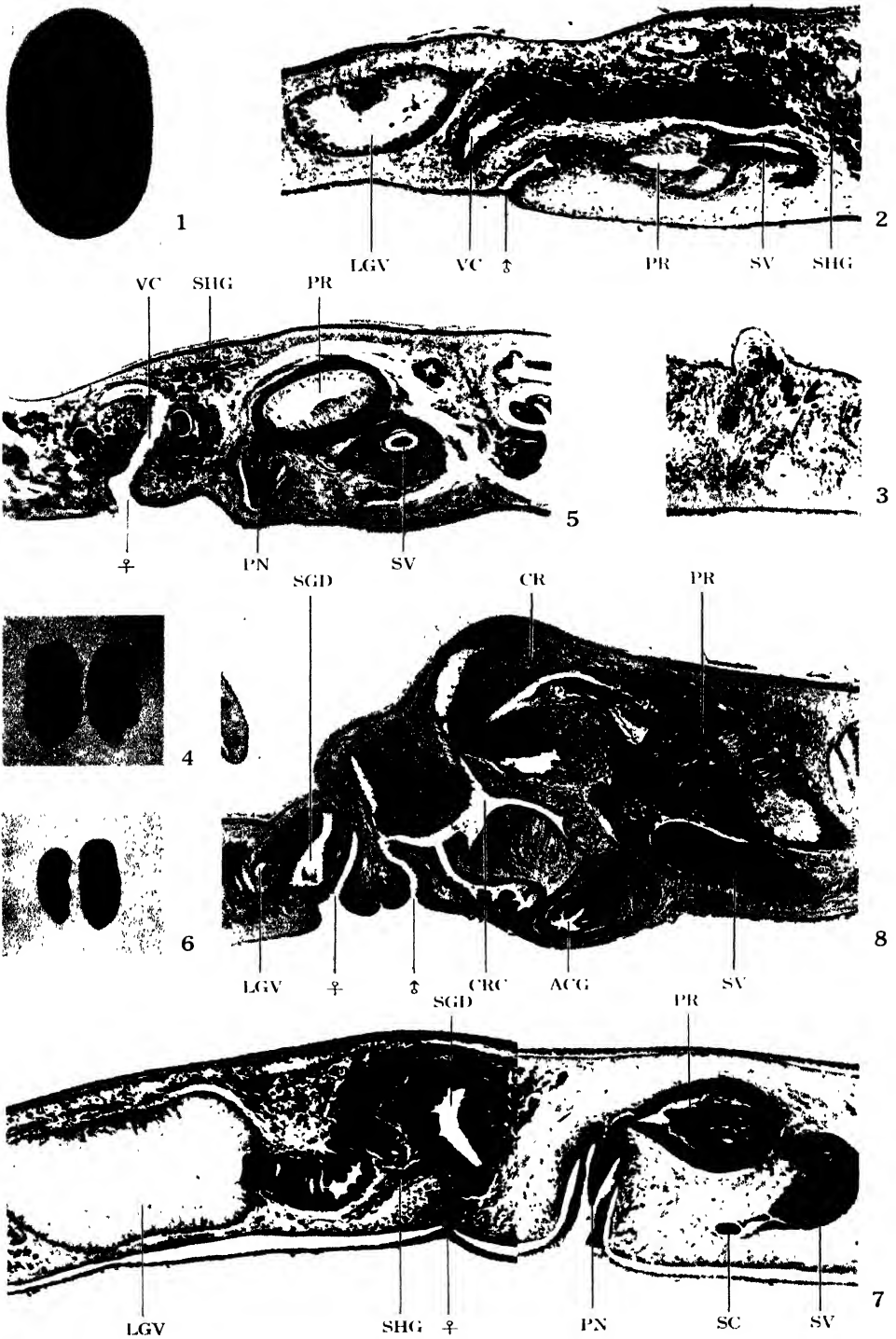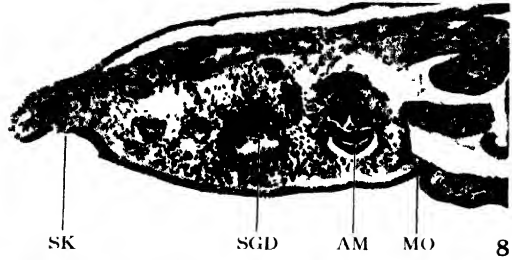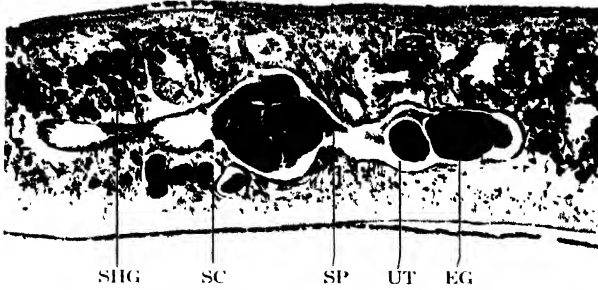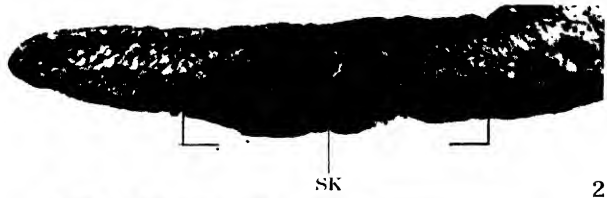
11. Polyclads from Korea

By Kojiro KATO

Mitsui Institute of Marine Biology, Susaki near Simoda

(With 9 Text-figures and Plate XVI)

The polyclads described in the present paper were collected by Mr. Siro Okuda of the Hokkaido Imperial University in July, 1936, in the coasts of Korea. Here, I should like to express my cordial thanks to him who kindly placed the valuable material at my disposal for study. The collection was found to comprise 8 species listed below, of which 4 appear to be new to science.

ACOTYLEA

Family Stylochidae
    1. *Leptostylochus* sp.
Family Leptoplanidae
    2. *Notoplana koreana* sp. nov.
Family Planoceridae
    3. *Planocera reticulata* (Stimpson)
Family Diplosolenidae
    4. *Pseudostylochus okudai* sp. nov.
    5. *Pseudostylochus longipenis* sp. nov.
    6. *Pseudostylochus elongatus* Kato

COTYLEA

Family Pseudoceridae
    7. *Pseudoceros luteomarginata* Yeri et Kaburaki
Family Prosthiostomidae
    8. *Prosthiostomum asiaticum* sp. nov.

1. *Leptostylochus* sp.
(Fig. 1)

In the collection there is a single individual of the Craspedommatous polyclad which was obtained at Saisyu in Saisyu Island.

The specimen was devoid of the posterior half of the body including the genital organs. The body is firmly textured and uniformly broad (about 5 mm) with a round anterior extremity.

The ground color of the body is dark brown without markings.

Tentacles are totally lacking but a few tentacular groups of eye-spots are present at the level of 2 mm distant from the anterior margin of the body. A large number of cerebral eye-spots are found over the brain region and indistinctly divided into two groups by the median line. A number of frontal eye-spots are also present. Marginal eye-spots are arranged densely along the body margin and decrease in number towards the middle of the body and then entirely disappear. The eyespots are so minute that they are visible only in well-clarified state.

It measures 6 mm from the frontal border of the body to the anterior extremity of the plicated pharynx. A pair of uteri can be traced from the level slightly in front of the anterior end of the pharynx.

Fig. 1. *Leptostylochus* sp.; arrangement of eye-spots. ×11

Judging from the external characteristics just mentioned, this Stylochid may reasonably be referable to *Leptostylochus* and seems to be more closely related to *L. elongatus* (Bock, 1925) from New Zealand than to *L. gracilis* (Kato, 1934) from Japan.

2. *Notoplana koreana* sp. nov.

(Figs. 2, 3; Pl. XVI, 3, 4.)

A single specimen of this species was collected at Gunzan on the western coast of Korea.

The body is elongated with a round anterior end and a slightly pointed posterior extremity. It measures 8 mm long by 3 mm broad.

In the preserved specimen, the dorsal surface is of a light brownish yellow color spotted with dark brown.

No tentacle is observed, but the tentacular groups of eye-spots are situated at the hind margin of the first sixth of the body. Cerebral eye-spots are scattered on either side of the brain.

The mouth lies at about the center of the body and leads into the pharyngeal
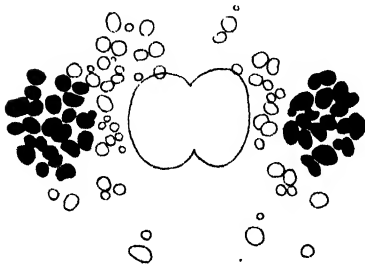
Fig. 2. *Notoplana koreana*; eye-spots. ×70

chamber occupying one-fifth the body length.

The seminal canals proceed forward from the hindbody to immediately behind the pharyngeal chamber and here turn mediad to join into a single canal which upwardly passes into the long tubular seminal vesicle provided with a thick muscular wall. On emerging from the upper end of the seminal vesicle, the ejaculatory duct pierces the pyriform prostate vesicle with a developed muscular coating. The prostate consists of a certain number of the saccular chambers arranged around the ejaculatory duct and opens into the latter at the distal end. Leaving the prostate, the ejaculatory duct takes an S-shaped course and merges into the muscular, elongated conical penis without stylet. The penis sheath passes posteroventrad into a strongly folded large antrum which opens out at the anterior limit of the third eighth of the body.
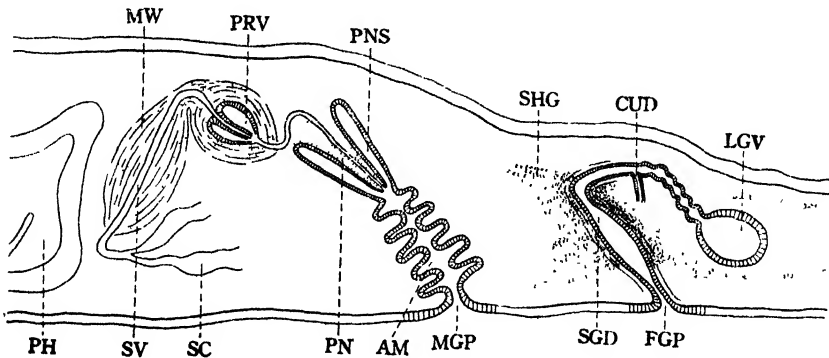
Fig. 3. *Notoplana koreana;* sagittal section through genital organs, schematized. ×60

Slightly behind the male genital pore opens the female pore which leads anterodorsally into the wide shell gland duct through a narrow antrum. The shell secretion is of spindle shape and abundantly gathers around the duct. Near the dorsal surface the shell gland duct turns posteriad and receiving a common uterine duct from ventrad continues to the moniliform duct from the moderately large Lang's glandular vesicle of a spherical shape.

The present species differs distinctly from any known species in the possession of the elongate penis sheath and antrum masculinum, the large muscular penis without stylet and in the total absence of tentacles.

3. *Planocera reticulata* (Stimpson)

Stylochus reticulatus Stimpson, 1855, p. 381; Diesing, 1862, p. 569.
Stylochoplana reticulata Stimpson, 1857, p. 4, 11.
Planocera reticulata Lang, 1884, p. 445.
Planocera reticulata (Stimpson) Yeri et Kaburaki, 1918, p. 19-22.

The collection contains two specimens obtained at Taisei in Saisyu Island. This species is widely distributed on the Pacific coast of Japan.

4. *Pseudostylochus okudai* sp. nov.

(Figs. 4, 5; Pl. XVI, 6.)

Two specimens which seem to represent a new species were collected at Zinsen on the western coast of Korea.

The body is of a typical *Pseudostylochus* type, oval in shape and rather firmly textured. It measures 20 mm long by 13 mm broad.

The color has nearly faded away except a large number of dark yellowish brown spots scattered uniformly over the dorsal surface of a light brown ground color.

At the hind margin of the first seventh of the body lie a pair of small tentacles, at the base of which are present tentacular eye-spots. Cerebral eye-spots are scattered chiefly in front of the level of the tentacles.

Fig. 4. *Pseudostylochus okudai;* eye-spots. ×35

The epidermis is slightly higher on the dorsal than on the ventral side and contains numerous rhabdites. The dermal musculature is not so well developed and consists of outer longitudinal and inner transverse muscle layers on the dorsal side and outer longitudinal, middle transverse and inner longitudinal on the ventral.

Enclosing the plicated pharynx, the pharyngeal chamber occupies the position of the second fourth of the body and opens out at the middle. Intestinal branches are numerous.

The testes lie, as usual, on the ventral side. The seminal canals, one on either side of the body, proceed backward to a little behind the pharyngeal chamber. Here they run mediad to join into a single duct which opens anteriorly into a seminal vesicle. The seminal vesicle is a wide tubular, Ω-shaped organ provided with a thick muscular wall and tapers toward posterodorsally to form an ejaculatory duct which, receiving the duct from the prostate vesicle on the dorsal side, turns postero-ventrally to open at the tip of an extremely small muscular penis devoid of stylet. The prostate vesicle lies between the dorsal epidermis and the distal part of the seminal vesicle and is crooked oval in shape. It is composed of a few saccular chambers and is surrounded by a developed muscular wall. The ejaculatory duct is also coated with a musculature. The penis is vertically disposed in a narrow penis sheath which is continuous ventrally with the dish-shaped antrum, which opens at its hind end.

The female genital pore lies slightly behind the male pore and is widely apart from the posterior end at the anterior extremity of the third tenth of the body. Surrounding the genital pore is developed the special sucking organ which consists of numerous concentric ridges of differentiated epidermis

which is thinner than the usual ventral epidermis. It contains no rhabdites but many fine secretion granules. The outermost circular ridge is about 0.8 mm in diameter. Similar structure has been recorded in certain *Leptoplana* species by Keferstein (1868) and Lang (1884), and seems to function at the time of oviposition. The vagina surrounded with much shell gland secretion goes anteriad for a long distance and turns abruptly posteriad and after receiving a common uterine duct meets a long duct from the Lang's glandular vesicle. The latter is a large elongate organ and is situated a little behind the level of the female genital pore. The ovaries are located on the dorsal side of the body.

This species differs from all known members of the genus, *Pseudostylochus obscurus*, *takeshitai*, *fulvus*, *fuscoviridis*, *elongatus* and *longipenis*, being characterized by the small penis, widely flat antrum masculinum as well as the sucking structure around the female genital pore.

5. *Pseudostylochus longipenis* sp. nov.

(Figs. 6, 7; Pl. XVI, 1, 2.)

A single specimen was collected at Gunzan on the western coast of Korea.

Although greatly contracted, one can detect by its general appearance resemblance to the foregoing species. The total length of the body is about 22 mm and the width is about 10 mm at the broadest part.

The color is almost gone.

A pair of small tentacles are present near the frontal margin of the body. Tentacular and cerebral eye-spots are arranged as shown in fig. 6.

The mouth lies at about the center of the body and leads into the pharyngeal chamber which occupies one-eighth the body length.

Proceeding backward from the forebody,
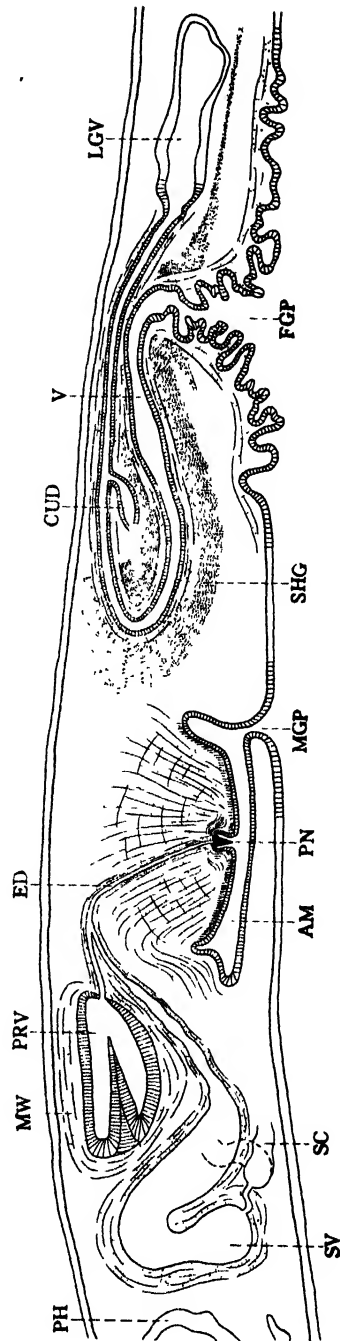
Fig. 5. *Pseudostylochus okudai*; sagittal section through genital organs, schematized. ×35

the seminal canals turn mediad to join into a single duct which anterodorsally pierces the thick muscular wall to open into the seminal vesicle.   Lying directly behind the posterior end of the pharyngeal chamber, the tubular seminal vesicle narrows posteriorly to merge into the base of the muscular penis and receiving the duct from the prostate opens out at the tip of the elongate penis. The prostate vesicle is situated above the posterior part of the seminal vesicle. It is a highly muscular organ and consists of numerous saccular chambers. The penis is tangentially disposed. In this specimen the most part of it extends outside the genital pore.

Fig. 6.   *Pseudostylochus longipenis;* eye-spots. ×35

The female genital pore lies immediately behind the
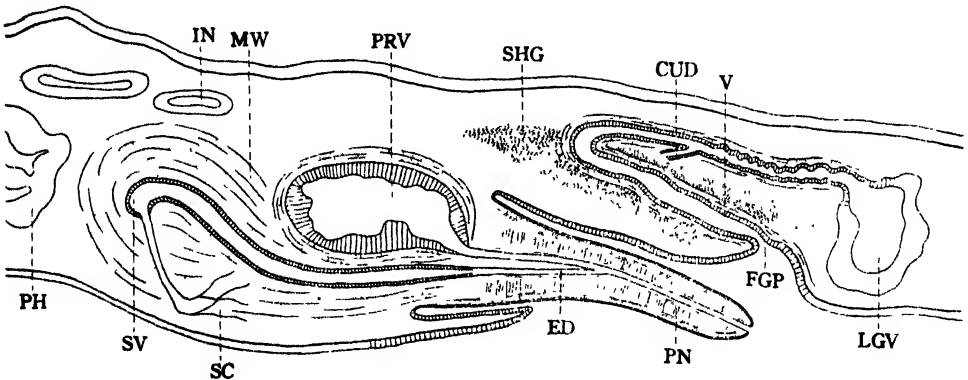
Fig. 7. *Pseudostylochus longipenis;* sagittal section through genital organs, schematized. ×35

male pore and widely apart from the posterior end of the body.   The vagina is long and receives numerous shell glands.   At the anterodorsal point the vagina curves backward to run for a short distance and after receiving a common uterine duct it continues to the moniliform duct from the moderately large Lang's glandular vesicle.

The elongate penis tangentially disposed resembles somewhat that of *Callioplana marginata* and characterizes this polyclad.

6.   *Pseudostylochus elongatus* Kato

Pseudostylochus elongatus Kato, 1937a, P. 218–220,

A single individual of this species was collected from Husan facing the Korean Straits. This is referable to *Pseudostytochus elongatus.*

It measures 10 mm long by 5 mm broad. The arrangement of eye-spots and the structures of the genital organs are quite in accord with those of the specimen obtained at Susaki near Simoda.

7. *Pseudoceros luteomarginata* Yeri et Kaburaki

Pseudoceros luteomarginata Yeri et Kaburaki, 1918, p. 37–39.

A single specimen of this species was obtained from Saisyu in Saisyu Island. It is readily identified as *Pseudoceros luteomarginata* of Misaki and Susaki by the characteristic coloration of the dorsal surface which is velvety black bordered with a yellowish brown color.

8. *Prosthiostomum asiaticum* sp. nov.
(Figs. 8, 9; Pl. XVI, 5.)

A single specimen of this new species was collected at Zinsen on the western coast of Korea.

As the specimen lacks the posterior half of the body, the total length of the animal is unknown. It measures 4.5 mm in breadth at the forebody and the sucker lies 7.5 mm apart from the anterior body end. The body is firmly textured and the anterior extremity is broadly rounded.

In the preserved specimen, the ground color of the dorsal surface is light brown, over which are scattered a large number of brown maculae and spots uniformly though somewhat denser along the median line.

The brain is located on the level of 1 mm apart from the anterior margin. Over the brain occur cerebral eye-spots, about 40 in number, and divided into two groups by

Fig. 8. *Prosthiostomum asiaticum;* arrangement of eye-spots. ×11

the median line. Numerous marginal eye-spots are arranged irregularly along the frontal margin.

The mouth lies immediately behind the brain and leads into the cylindrical pharynx measuring about 3 mm in length. From the anterior end of the main intestinal trunk a median branch runs forward along the dorsal side of the pharyngeal chamber.

The sucker is of medium size.

The genital organs are of a Prosthiostomid-type. On the level of the hind margin of the pharyngeal chamber, the male genital pore passes postero-dorsally into a wide antrum which continues into the elongate penis sheath. The penis is provided with a long chitinous stylet. The penis sheath is constricted

slightly in the middle portion and into its lower portion open a great number of prostate glands. As soon as the ejaculatory duct emerges from the base of the penis, it curves ventrad and after receiving the ducts from the paired small accessory glands, enlarges into a large seminal vesicle with a thick muscular coating. Proceeding from the hindbody to the level of the seminal vesicle, a pair of the seminal canals turn mediad and open into the seminal vesicle at each posterolateral ends.
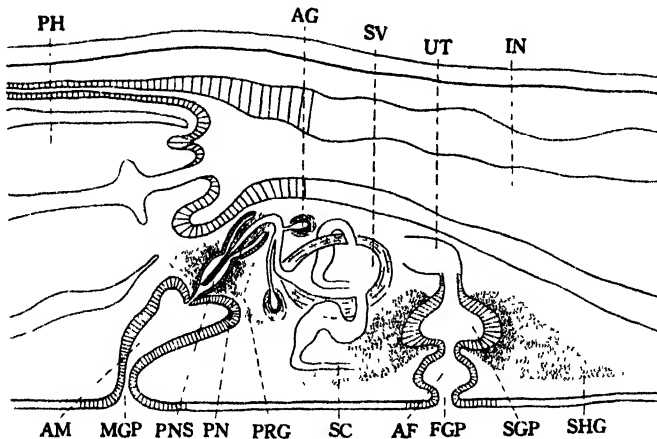
Fig. 9. *Prosthiostomum asiaticum;* sagittal section through genital organs, schematized. ×60

A little behind the male genital pore lies the female pore, which passes into the shell gland pouch through the small antrum. The latter narrows dorsally and soon receives anteriad a pair of the uteri.

Over 20 species have been recorded under the genus *Prosthistomum.* The present animal is easily distinguished from all others in the characteristic arrangements of eye-spots and genital organs.

<div align="center">LITERATURE</div>

List of literature cited is appended to the foregoing paper.

<div align="center">EXPLANATION OF PLATE XVI</div>

1, 2 *Pseudostylochus longipenis* sp. nov., longitudinal sections through genital organs. ×25
3, 4 *Notoplana koreana* sp. nov., longitudinal sections through genital organs. ×40
5 *Prosthistomum asiaticum* sp. nov., longitudinal section through genital organs. ×40
6 *Pseudostylochus okudai* sp. nov., longitudinal section through genital organs. ×25

<div align="center">ABBREVIATIONS</div>

AG accessory gland; AF antrum femininum; AM antrum masculinum; CUD common uterine duct; ED ejaculatory duct; FGP female genital pore; IN intestine; LGV Lang's glandular vesicle; MGP male genital pore; MW muscular wall; PH pharynx; PN penis; PNS penis sheath; PRG prostate gland; PRV prostate vesicle; SC seminal canal; SGD shell gland duct; SGP shell gland pouch; SHG shell gland; SV seminal vesicle; UT uterus; V vagina.
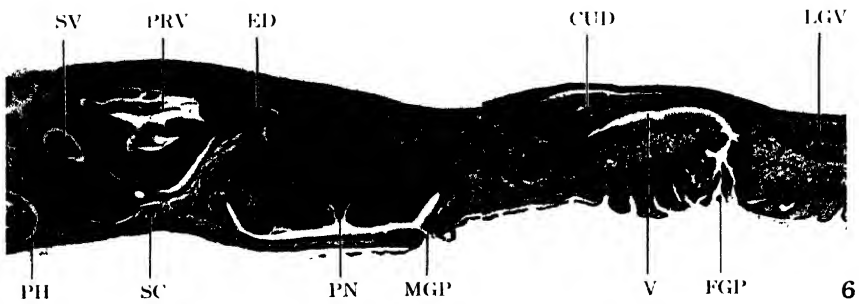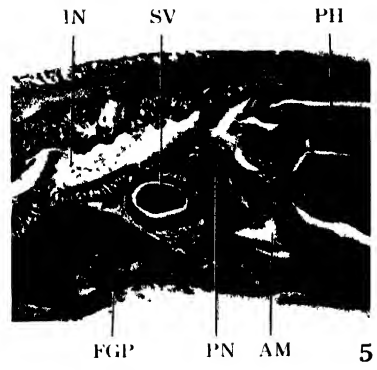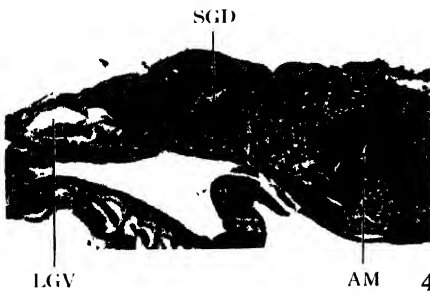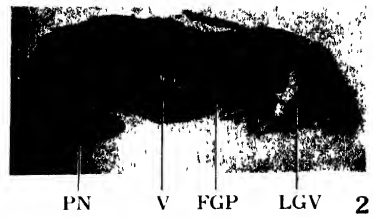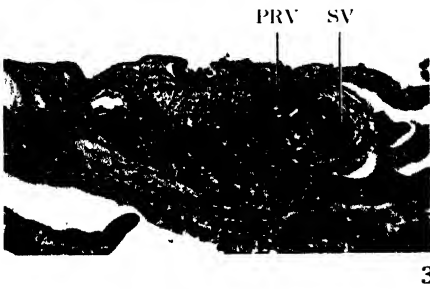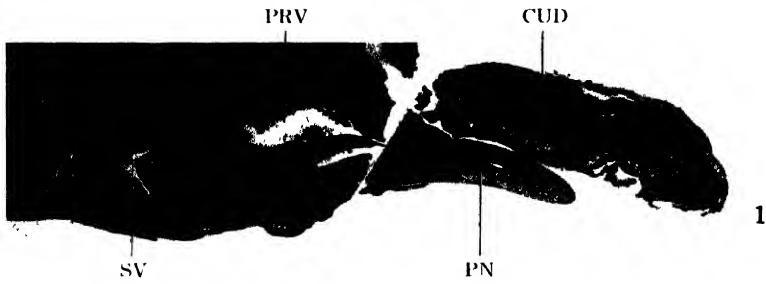
12. Migration of Calcium through Blood in Ligia exotica during its Moulting.[1]

By Haruo NUMANOI

Urawa Kôtôgakkô, Urawa

(With 3 Text-figures and 5 Tables)

I

"Chalky whiteness" (Tait 1916–1917), presumably the temporary reservoir of calcium in the ventral skin of thoracic segments of *Ligia exotica* fades away within a few days after the moulting of the posterior half of the carapace forming instead calcareous deposit in pleopods. The deposit persists until the moulting of the anterior half, but fades in turn after the completion of the ecdysis. This may be due to the migration of calcium from one to the other half of the body through the circulatory medium.

Since the amount of calcium content in the exuvia is remarkably small — about $1/4$ of the normal carapace — and only slight increase of the ingredient is detected in muscles and internal organs during moulting (Numanoi 1934 b), it may be concluded that the rest of the calcium in the reservoir may be utilized as the source of material for the new carapace in which at first no calcium is contained. Thus, the migration of calcium from the old carapace to the temporary reservoir and from it to the new carapace may be effected through the blood. But in fact calcium content in the blood remains at a usual level (Numanoi 1934 a) during the formation of "chalky whiteness", not increasing until the posterior carapace has been cast off in the ecdysis.

The present study was carried out to know the chemical properties of calcium compound in carapace and in "chalky whiteness". And also it is attempted to make clear, whether the increased amount of calcium in the blood is derived from the calcium reservoir or not; and whether the calcium compound in the blood takes an inorganic dialysable form or non-dialysable one by the combination with blood protein.

I here express my cordial thanks to Professors Yatsu, Kamada and Yamamoto of the Tokyo Imperial University, and Mr. Kikuzawa, the late principal of the Urawa Kôtôgakkô for their kind guidance and encouragement. Also thanks are due to the Mitsui Institute of Marine Biology where facilities for the present investigation were afforded during the summer of 1935. The study was partly aided by the grant of the Ministry of Education.

II

Concerning the materials and methods of experiments full descriptions were given in my previous paper (1934 a). About 1 cc of blood was collected from 15 fully grown males of the same moulting stage. Blood clotting was prevented by adding a known amount of 0.5% sodium citrate. One half of the blood material was deproteinated, and the amount of calcium content was determined by the method of Kramer and Tisdall (1921).

A brief note on the preparation of collodion sac here used may not be overfluous. The sac was prepared by modifying Looney's method (1922). Collodion solution was made by dissolving 5 gm of dried Anthony's negative cotton in a mixture of 25 cc of absolute ethyl alcohol and 75 cc of ether. After dipping a small test tube into the solution and taking it out the collodion membrane was allowed to drain for 3 minutes in the air. The tube was immediately immersed in the water for about 5 minutes and the hardened collodion membrane was then stripped off. This was preserved in the water until use. The aqueous solution of congo red was dialysed in this sac against distilled water in order to test the semi-permeability of the membrane. In the case where the dye diffused into the surrounding water, the sac was discarded from the use.

Another half of the blood material was dialysed against 10 cc of distilled water for 2 days changing the water every 12 hours. Instead of the collodion sac, purchasable "fish skin", the swim-bladder of fish was used as the dialysing sac. The result well agreed to that when the collodion sac was used.

After 2 days' dialysis using either collodion sac or "fish skin" external water was collected and the amount of dialysable calcium was determined by the same method as the total calcium determination.

III

The migration of calcium in *Ligia exotica* may be divided into three phases according to moulting stages.

1st phase (Stage A–B)[1]: "Chalky whiteness" begins to develop in the ventral skin of the anterior thoracic segments. At the high time of the "whiteness" formation, the posterior carapace is cast off.

During the phase calcium contained from non-moulting stage in the blood and also newly dissolved in it from the posterior carapace is thought to be precipitated in the anterior thoracic segments forming "chalky whiteness", since at that time the calcium content of the posterior exuvia decreases to only $1/4$ of the normal carapace. And on the other hand the amount of dialysable calcium in the blood stands quite stationary, because, as it is, it must be again precipitated to form the "chalky whiteness" in the anterior carapace.

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[1] Moulting was divided into 4 stages, i. e., A, B, C, and D according to the morphological changes. See my previous paper (1934 a).

Table 1

Calcium content in blood of *Ligia exotica* during non-moulting and moulting.

Stage	Forms of calcium	Number of individuals used	Calcium content in 1 cc blood	
			mg	%
Non-moulting				
	Total calcium	12	0.97±0.06	
	Dialysable calcium	17	0.72±0.02	74.2
	Non-dialysable calcium		0.25±0.06	25.8
Moulting				
A	Total calcium	8	1.00±0.05	
	Dialysable calcium	15	0.75±0.03	75.0
	Non-dialysable calcium		0.25±0.06	25.0
B	Total calcium	11	0.97±0.03	
	Dialysable calcium	29	0.79±0.02	81.4
	Non-dialysable calcium		0.18±0.04	18.6
C	Total calcium	5	1.26±0.12	
	Dialysable calcium	8	1.08±0.04	85.7
	Non-dialysable calcium		0.18±0.13	14.3
D	Total calcium	10	1.28±0.06	
	Dialysable calcium	23	0.82±0.02	64.1
	Non-dialysable calcium		0.46±0.06	35.9
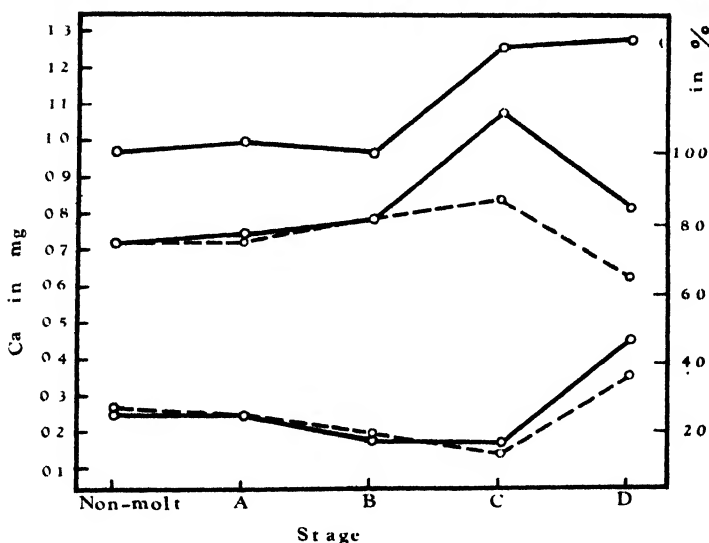
Fig. 1 Calcium content in 1 cc of blood during non-moulting and moulting phases. Upper curve shows total, middle dialysable, lower non-dialysable blood calcium. Dotted curves show 2 forms of calcium in percentage.

Both the total amount of calcium and the ratio, 1:3, of non-dialysable and dialysable forms remain quite constant (Table 1).

2nd phase (Stage B–C): "Whiteness" gradually fades away forming calcareous deposit in the pleopods. After completing the deposition, the moulting of the anterior carapace begins to take place.

The calcium content of the blood increases about 1.3 times that of the former phase, and the ratio of non-dialysable and dialysable calcium becomes 1:6, as the result of a slight decrease of the former and remarkable increase of the latter. The high level of the dialysable calcium may be caused by the dissolution of the "chalk whiteness" and the calcium contained in the anterior carapace. Some part of this blood calcium must be consumed for hardening the posterior new carapace and also to form the calcareous deposit in the pleopods.

3rd phase (Stage C–D): Calcareous deposit in the pleopods disappears and the anterior carapace hardens.

The blood calcium still remains in a high level, yet the ratio of non-dialysable and dialysable calcium now becomes 1:2 as the result of the sudden increase of the former and the recovery of the latter to the normal level. This state of affairs may presumably be explained by the conception that some amount of the dialysable calcium is transformed into the non-dialysable by its combination with blood protein or some other colloidal substances.

Generally speaking, the direction of the migration of calcium may be from posterior towards anterior in the 1st phase, and it is reverse in the 2nd, while in the 3rd it again returns to that of the 1st (Fig. 2).
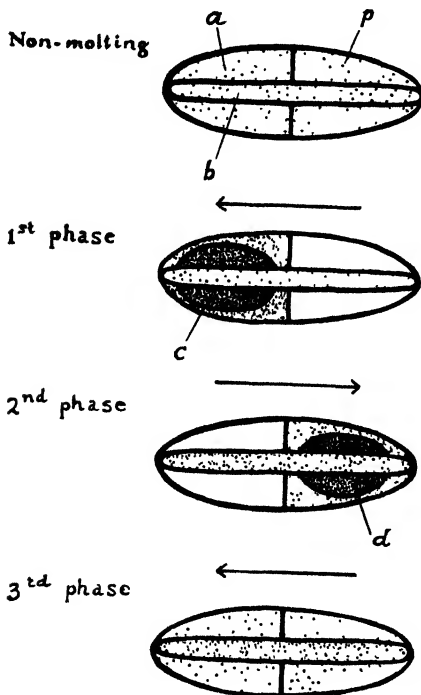
Fig. 2 Diagrammatic illustration of calcium migration in *Ligia exotica* during moulting. a, anterior carapace; b, blood vessel; c, "chalky whiteness"; d, calcareous deposit; p, posterior carapace. Arrows show direction of migration of calcium through blood.

IV

In order to know the mechanism of the transformation of the crystalline calcium into the dialysable form in the blood, blood pH was determined. A series of mixtures were prepared by the mixing of 0.1 cc of 0.5% sodium

citrate, 0.01 cc of phenol red and 0.2 cc of Sφrensen's phosphate solution, the last of which is different in the ratio of the two phosphates used. The mixtures were introduced into a series of capillary tubes (5 cm long, 1 mm diameter). Thus, a series of capillary tubes containing phosphate buffer solution of different components as above said were used for the present test. Similar mixture but containing 0.2 cc of blood instead of phosphate buffer solution was introduced into a capillary. By comparing the colour tones of the capillary containing the blood with those of buffer solution under the microscope of low power with white-back ground, the pH was determined.

Table 2

Blood pH of *Ligia exotica* during moulting

Stage	Non-moulting	Moulting			
		A	B	C	D
Number of individuals used	8	6	6	9	10
pH	7.80±0.10	7.50±0.03	7.55±0.03	7.55±0.03	7.65±0.07

The result is summarized in Table 2. The blood pH of the non-moulting phase is slightly alkaline as in the case of vertebrates. With the commencement of the moulting, a slight decrease of pH occurs and after then it maintains its low value during the moulting but returns to normal when the moulting is over.

The blood calcium of vertebrates is said to be in the state of equilibrium as is shown in the following manner:

$$CaCO_3 + CO_2 + H_2O \rightleftarrows Ca(HCO_3)_2 \rightleftarrows Ca^{\cdot\cdot} + 2HCO_3{'}$$
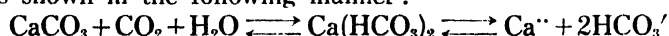
Judging from the model experiment, it is quite certain that calcium carbonate does not dissolve in the hydrochloric acid unless the pH of it is less than 5.0 under normal atmospheric CO_2 pressure and at room temperature of 25°C. Paul and Sharpe (1916) supposed that the blood calcium of *Cancer* would not combine with inorganic chlorine or sulfur, but combine with some organic acid forming a soluble CaX. The writer also suggests that under alkaline condition, the blood calcium can not simply combine with any inorganic acid. Presumably a complicated system with carbonic acid, soluble calcium bicarbonate in the blood and the insoluble calcium carbonate in the calcium reservoir may exist in *Ligia*. Moreover, the organic acids contained in the hepato-pancreas may play an important rôle for the control of calcium.

V

In order to confirm the idea expressed in chapter IV, the properties of calcium compound in carapace, exuvia and calcium reservoir (" chalky white-

ness " of the thoracic carapace and calcareous deposit in the pleopods) were studied.

It is chemically proved that calcium carbonate can be dissolved in a dilute hydrochloric acid, while calcium phosphate not. The latter can only be dissolved in a concentrated nitric acid. Calcium compound in the crustacean exóskeleton is the mixture of phosphate and carbonate. These calcium compounds cannot be quantitatively measured simply by the analysis of phosphate and carbonate, since there co-exist the salts of magnesium and other allied cations combined with these anions.

After dissolving away the muscle of *Ligia* by potassium hydroxide the residue was perfectly dried in the desiccator, and then transferred into 5% hydrochloric acid in which it was left for a day to dissolve the calcium therein contained. Calcium amount dissolved in this acid was determined by the method of Kramer and Tisdall. The residue insoluble in the hydrochloric acid was again dried perfectly and put into 15% nitric acid for a day to dissolve the calcium phosphate. Calcium amount dissolved in this acid was also determined by the same method. The residue which was insoluble in both acids may presumably be chitin. As are shown in Table 3, not only the amount of soluble substance in hydrochloric acid but also the calcium content in the carapace decrease as the moulting proceeds, while that soluble in nitric acid increases gradually with the ecdysis. On the other hand the amount of residue is always constant.

Table 3

Calcium content in carapace of *Ligia exotica* during non-moulting and moulting.

Stage	Number of individuals used	Dry weight mg (Min.-Max.) Mean	Weight of soluble matter in HCl		Weight of CaCO$_3$		Weight of soluble matter in HNO$_3$		Weight of Ca$_3$(PO$_4$)$_2$		Weight of residue	
			mg	%	mg	%	mg	%	mg	%	mg	%
Non-moulting	10	(147-372) 213.3	126.7	59.4	19.1	9.0	9.2	4.3	—	—	77.4	36.3
Moulting Stage A	14	(128–371) 198.5	111.6	56.2	15.8	7.9	13.3	6.7	—	—	73.6	37.1
Stage B	15	(187–316) 219.9	118.7	54.0	17.9	8.2	19.8	9.0	—	—	81.4	37.0
Stage C	11	(106–266) 156.5	85.9	54.9	11.9	7.6	11.4	7.3	—	—	59.2	37.8
Stage D	11	(129–339) 194.1	98.2	50.6	14.4	7.4	22.5	11.6	—	—	73.4	37.8

From the result (Table 3) it may be said that almost all calcium contained in the carapace is of carbonate, since only a trace of calcium was detected in the solution dissolved by the nitric acid.

Table 4

Calcium compound in "chalky whiteness" and calcareous deposit.

Stage	Dry weight of reservoir mg	Weight of soluble matter in HCl		Weight of CaCO₃		Weight of soluble matter in HNO₃		Weight of Ca₃(PO₄)₂		Weight of residue	
		mg	%	mg	%	mg	%	mg	%	mg	%
A	245	133	54.3	88.2	36.0	65	26.5	1.15	0.46	47	19.2
B	587	365	62.2	217.5	37.1	137	23.3	0.81	0.14	85	14.5
C	487	402	82.5	271.5	55.7	54	11.1	1.01	0.21	31	6.4
D	1762	1552	88.1	1175	66.7	142	8.1	1.35	0.08	68	3.8

In each of all analyses 90 individuals were used.

The properties of the calcium contained in the calcium reservoir were tested by the same method. As shown in Table 4, the amount of calcium carbonate in the 1st phase is always 36–37% of the dry weight, while in the later stages it increases and is found much more. So that, it can be conceivable that, though the calcareous deposit in pleopods does not seem very conspicuous in its appearance, yet it is in fact the most effective reservoir of calcium. The amount of calcium phosphate is decidedly inconspicuous compared to that of carbonate. The present result agrees well with that of the "chalky whiteness" of *Ligia oceanica* studied by Nicholls (1931).

Table 5

Calcium compound in exuvia

A Thoracic exuvia (abandoned carapace by anterior moulting)

Set*	Dry weight of exuvia mg	Weight of soluble matter in HCl		Weight of CaCO₃		Weight of soluble matter in HNO₃		Weight of Ca₃(PO₄)₂		Weight of residue	
		mg	%	mg	%	mg	%	mg	%	mg	%
I	154	67.0	43.5	56	36.4	75.8	49.2	—	—	11.2	7.3
II	137	62.1	45.3	51	37.2	63.4	46.3	—	—	11.5	8.4
III	162	74.0	45.7	58	35.8	75.0	46.3	--	—	13.0	8.0
IV	178	82.9	46.6	67	37.6	82.1	46.1	—	—	13.0	7.3

B Abdominal exuvia (abandoned carapace by posterior moulting)

Set*	mg	mg	%	mg	%	mg	%	mg	%	mg	%
I	218	107.0	49.1	87	39.9	95.9	44.0	—	--	15.1	6.9
II	215	107.9	50.2	88	40.9	92.0	42.8	—	---	15.1	7.0
III	205	94.9	46.3	81	39.5	95.9	46.8	—	—	14.2	6.9

* Each set consists of 20 exuviae

The analysis of exuvia was also carried out (Table 5). About 40% of the dry weight of it is calcium carbonate, while calcium phosphate is contained only in a trace.

In order to know the physical properties of calcium compounds in the carapace, a microscopical photograph was taken by polarized light (Fig. 3).

A   B
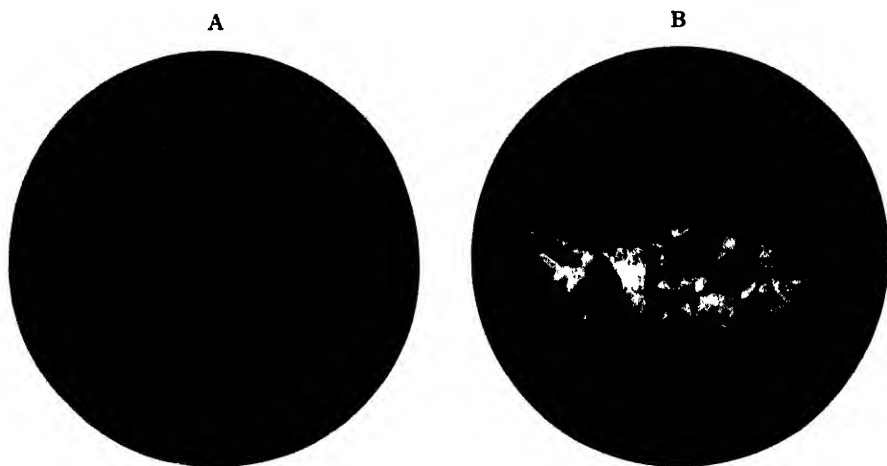
Fig. 3   Photograph showing crystal form of calcium compound in carapace, taken by polarized light.
A   Dorsal aspect of carapace in non-moulting phase. ×115
B   Early calcium precipitation along thoracic suture forming "chalky whiteness".
    ×115

Fig. 3, A clearly shows that calcium carbonate in the carapace is crystallized and its crystal form is quite similar to that of calcite, its interference figure being unipolar. Same manipulation was carried out on the "chalky whiteness" newly precipitated and it is found that the precipitate is also of crystal nature (Fig. 3 B). In what form does the calcium dissolve in the blood? it is not yet clear. The present study does not reach so far.

SUMMARY

1.   The process of calcium migration may be divided into three phases; 1st phase: Calcium dissolved from the posterior carapace forms "chalky whiteness" in the anterior thoracic segments. The exuvia contains only $1/4$ of the normal amount of calcium in the carapace. Both the total amount and the ratio of non-dialysable and dialysable calcium in the blood i. e., 1:3 remains quite constant during the phase. 2nd phase: The blood calcium increases about 1.3 times of the 1st phase and the ratio of the two forms of calcium becomes 1:6. The high level of the dialysable calcium may be caused partly by the dissolution of the "chalky whiteness". 3rd phase: The blood calcium still retains a high level and the ratio of the two forms of calcium becomes 1:2.

This may be due to the fact that the dialysable calcium is transformed into the non-dialysable by the combination with blood protein.

2. The direction of the migration of calcium may be from posterior towards anterior in the 1st phase, and the reverse in the 2nd, while in the 3rd it returns again to that of the 1st.

3. The blood pH of the non-moulting *Ligia* is slightly alkaline and its value decreases with the moulting.

4. Almost all calcium contained in the carapace, calcium reservoir and exuvia is in the form of calcium carbonate. The amount of calcium phosphate is inconsiderable.

5. The carapace contains about 8%, "chalky whiteness" 37%, calcareous deposit 55–65% and exuvia 36–41% of calcium carbonate respectively per dry weight.

6. The calcium compound in the carapace and the "chalky whiteness" was examined by the polarized light. Their interference figures are both unipolar and quite similar to that of calcite.

<div align="right">November 15, 1936</div>

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13. Copepods from the Deep Water of Suruga Bay

By Otohiko Tanaka

Mitsui Institute of Marine Biology, Susaki near Simoda

(With 19 Text-figures and Plates XVII–XIX)

The material was collected by a single vertical haul from the depth of 500 m up to 250 m with a closing net of diameter 60 cm off the coast of Heda, Sizuoka-ken, in June 1936. The collection was rich in numbers of both specimens and species of copepods. Most of the species have not hitherto been reported from Japanese waters. Among them 1 species belonging to the genus *Xanthocalanus*, 2 to *Scaphocalanus* and 1 to *Paratharybis* n. gen. are new to science. The hydrographycal condition in the depth of 500 m was, the temperature, 7.1°C and the salinity, 34.34‰.

Family CALANIDAE

Genus *Calanoides* Brady

1. *Calanoides brevicornis* (Lubbock)

(Fig. 1, a–d)

Calanus brevicornis, Giesbrecht, 1892, p. 90, t. 6, 7, 8.
Calanus brevicornis, Giesbrecht und Schmeil, 1898, p. 16.
Calanoides brevicornis, A. Scott. 1909, p. 10.

Remarks. The specimen is an immature female in the 5th copepodid stage. Length, 2.75 mm, cephalothorax, 1.18 mm, abdomen, 0.57 mm. The cephalothorax is elongate ovate in dorsal view. The head is separated from the 1st thoracic segment, the 4th segment separated from the 5th. The last thoracic segment is obtusely triangular in outline in lateral view. Rostral filaments are long.

The antennules are 25-jointed and extend to the end of the anal segment.
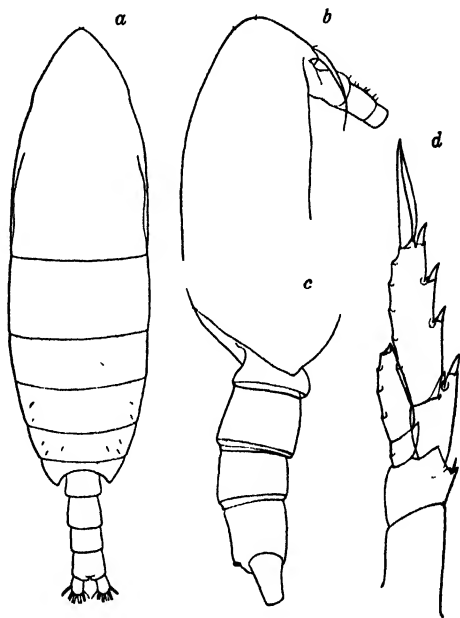
Fig. 1. *Calanoides brevicornis*. Female, juv. a, dorsal view, ×9; b, head, lateral view, ×30; c, abdomen, lateral view, ×30; d, 5th leg, ×90.

The oral appendages are in the main feature alike to those of *Calanus*. Legs 1-4 have 3 segments in exopodites as well as in endopodites.

In the 1st leg, the 3rd segment of the exopodite bears 2 marginal spines and 4 inner setae. In the 2nd to 4th legs, the 3rd segment of the exopodite bears 2 outer marginal spines and 5 inner setae. The 5th pair of legs have 2-segmented exopodite and endopodite, the limitation between 2nd and 3rd segment yet undetectable.

Occurrence.   One immature female.

Distribution.   The species has been recorded from the Indian Ocean and Malay Archipelago.

Family PSEUDOCALANIDAE
Genus *Clausocalanus* Giesbrecht
1.   *Clausocalanus arcuicornis* (Dana)

(Fig. 2, a–d)

Clausocalanus arcuicornis, Giesbrecht, 1892, p. 186, t. 1, 2, 10, 36.
Clausocalanus arcuicornis, Giesbrecht und Schmeil, 1898. p. 27.
Clausocalanus arcuicornis, A. Scott, 1909, p. 32.
Clausocalanus arcuicornis, Gurney, 1926, p. 150.
Clausocalanus arcuicornis, Farran, 1929, p. 223.
Clausocalanus arcuicornis, Sewell, 1929, p. 90, Figs. 36, 37.
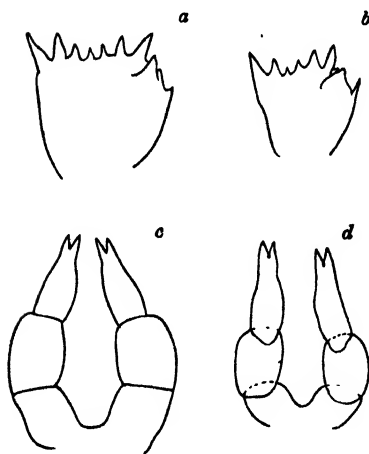
Fig. 2. *Clausocalanus arcuicornis*. Female.
a, 2nd basipodite of 2nd leg, large specimen, ×110; b, 2nd basipodite of 2nd leg, small specimen, ×110; c, 5th leg, large specimen, ×240; d, 5th leg, small specimen, ×240.

Sewell and other authors called attention to the existence of two forms of *Clausocalanus arcuicornis*, different from each other both in size and in anatomical characters. My smallest specimen measures 1.13 mm and the largest 1.16 mm. Those specimens differ in the number of teeth on the distal margin of the 2nd basipodite of the 2nd leg and in the proportional length of the segments of the 5th legs. Previously I found in a surface collection one female specimen, which had the same structure in the 5th pair of legs as the figure given by Sewell as *C. arcuicornis forma minor*; the length of that specimen was 1.07 mm.

Occurrence.   Six adult females.

Distribution.   This species has a wide distribution in the Pacific, Atlantic and Mediterranean.

Genus *Ctenocalanus* Giesbrecht
Ctenocalanus vanus Giesbrecht

(Fig. 3, a–c)

Ctenocalanus vanus, Giesbrecht, 1892, p. 194, t. 10, 36.
Ctenocalanus vanus, Giesbrecht und Schmeil, 1898, p. 28.
Ctenocalanus vanus, Esterly, 1924, p. 90, fig. D.
Ctenocalanus vanus, Farran, 1929, p. 226.

Remarks. Length, female, 1.27 mm, cephalothorax, 0.93 mm, abdomen, 0.34 mm. The species resembles *Clausocalanus* but differs in the following points: the rostrum consists of slender filaments, the outer marginal spines on the 3rd segment of the 3rd and 4th pair of legs are of ctenate form, the distal border of the 2nd basipodite of the 2nd and 3rd pair of legs are not serrated.

Occurrence. One adult female.

Distribution. This species has been recorded from the Pacific and Mediterranean.

Genus *Spinocalanus* Giesbrecht
Spinocalanus abyssalis Giesbrecht

(Fig. 4, a–c)

Spinocalanus abyssalis, Giesbrecht, 1892. p. 209, t. 13, 36.
Spinocalanus abyssalis, Giesbrecht und Schmeil, 1898, p. 31.
Spinocalanus abyssalis, Sars, G. O., 1903, p, 22, 157. Pl. XII, Suppl. Pl. III.
Spinocalanus abyssalis, With, 1915, p. 69, Pl. I, Fig. 15, a–e.
Spinocalanus abyssalis, Farran, 1929, p. 227.

Remarks. Female, length, 1.98 mm, cephalothorax, 1.46 mm, abdomen, 0.52 mm. Seen from the dorsal, the body is oblong ovate in outline. The frontal margin of the head is obtusely rounded. The head separated from the 1st thoracic segment. The 4th and 5th segment are separated. The lateral corner of the last thoracic segment is obtusely rounded. The rostrum is absent.

The abdomen is composed of 4 segments. The combined length of the abdomen and furca is contained 2.8 times in the length of the cephalothorax. The length of the abdominal segments and furca in 0.01 mm is 16, 12, 9, 8 and 7 respectively. The ventral protuberance of the genital segment is less
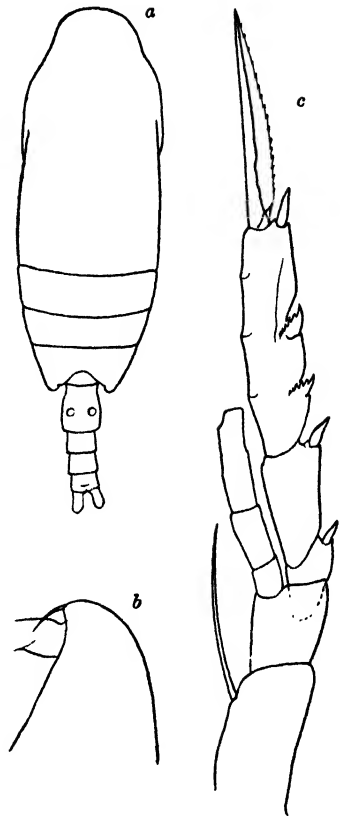
Fig. 3. *Ctenocalanus vanus.* Female.
a, dorsal view, ×40; b, head, lateral view, ×60; c, 3rd leg, ×170.
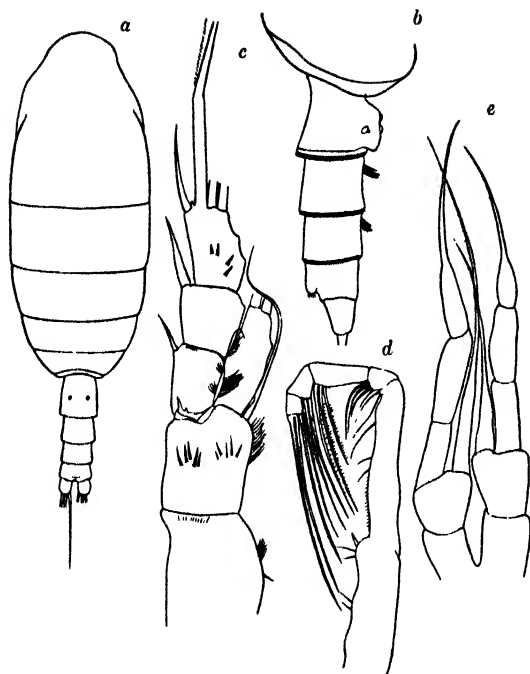
Fig. 4. *Spinocalanus abyssalis*. Female.
a, dorsal view, ×30; b, abdomen, lateral, ×120;
c, 1st leg, ×170. Male: d, 2nd maxillipede,
×120; e, 5th leg, ×240.

prominent than that figured by Giesbrecht. There are fine hairs on the ventral side of the 2nd and 3rd segment. The distal margin of the segments 1–3 inclusive are finely striated.

The antenules are unfortunately damaged.

The oral appendages are alike the figures given by Giesbrecht. In the mandible, there are several rows of spines on the ventral surface of the 2nd basipodite.

The natatory legs are scarcely different from the Giesbrecht's description. The outer marginal spine on the 1st segment of the exopodite of the 1st leg is more slender and shorter. Spinules are observed on the ventral surface of the 3rd exopodite of the 1st pair of legs. The 3rd and 4th pair of legs are unfortunately broken.

Male, length, 1.62 mm, cephalothorax, 1.14 mm, abdomen, 0.48 mm. The male has general resemblance to the female. The frontal margin of the head is contracted in the middle. The head is fused with the 1st thoracic segment; the 4th and 5th thoracic segments are separated.

The abdomen is 5-segmented.

The antennules are 24-jointed.

The 5th pair of legs are as With's figure.

Occurrence. One adult female and one male.

Distribution. This species has been recorded from deep waters of the Pacific, west coast of Ireland and coast of Norway.

<div align="center">

Family AETIDEIDAE
Genus *Chiridius* Giesbrecht
Chiridius poppei Giesbrecht

(Fig. 5, a–c)

</div>

Chiridius poppei, Giesbrecht, 1892, p. 224, t. 14, 36.
Chiridius poppei, Giesbrecht und Schmeil, 1898, p. 33.

Chiridius poppei, A. Scott, 1909, p. 41, Pl. XI.
Chiridius poppei, Farran, 1929, p. 229.

Remarks. Length, female, 1.83–1.87 mm. The specimen agrees quite well with the description and figures given by Giesbrecht. The distal margin of the 1st abdominal segment is furnished with fine spinules and the 2nd and 3rd with small serrated plates. The terminal spine of the exopodite of the 3rd pair of legs has 23 and the 4th pair 22 teeth.

Occurrence. Two adult female in the collection.

Distribution. The Malay Archipelago, Mediterranean and Tasmanian Sea, collected from the surface.

Chiridius gracilis Farran ?

(Fig. 6, a–f)

Chiridius gracilis, A. Scott, 1909, p. 42, Pl. XI.
Chiridius gracilis, With, 1915, p. 85, Fig. 21.
Chiridius gracilis, Farran, 1929, p. 229, Fig. 6.
Chiridius gracilis, Sewell, 1929, p. 100.
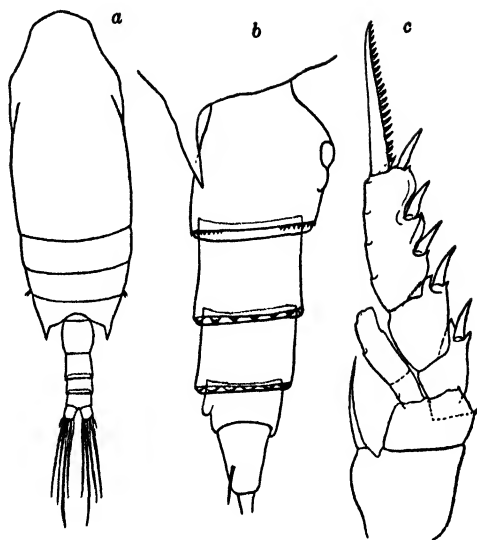
Fig. 5. *Chiridius poppei*. Female. a, dorsal view, ×30; b, abdomen, lateral, ×120; c, 2nd leg, ×120.

Remarks. Length, female, 2.57–2.64 mm, cepholothorax, 1.94 mm abdomen 0.66 mm. The cephalothorax is more robust than in *Ch. poppei*. The frontal margin of the head is obtusely rounded. The lateral spines on the last thoracic segment rather convergent and project to the middle of the genital segment; the distance between spines is half the greatest width of the cephalothorax.

The combined length of the abdomen and furca is slightly longer than 1/3 of the cephalothorax; the genital segment is about as long as the 2nd and 3rd segment together. The 2nd segment is longer than the 3rd. The anal segment is equal to half the length of the 3rd segment. The furcal rami are longer than the anal segment and $1^{1}/_{3}$ as long as wide.

The antennules differ from those of *Ch. poppei*. The 20th joint is more than 4-times as long as wide, while in *Ch. poppei* it is exactly 4-times.

The 2nd basipodite of the mandible is longer than that of *Ch. poppei*. In the other mouth appendages scarcely any difference was observed.

In the 1st pair of legs the outer marginal spine of the 1st segment of the exopodite extends to the base of the 2nd segment. In the 2nd pair of legs, the endopodite does not extend to the base of the 3rd segment of the exopodite. In the 3rd pair of legs, the endopodite is shorter than that of
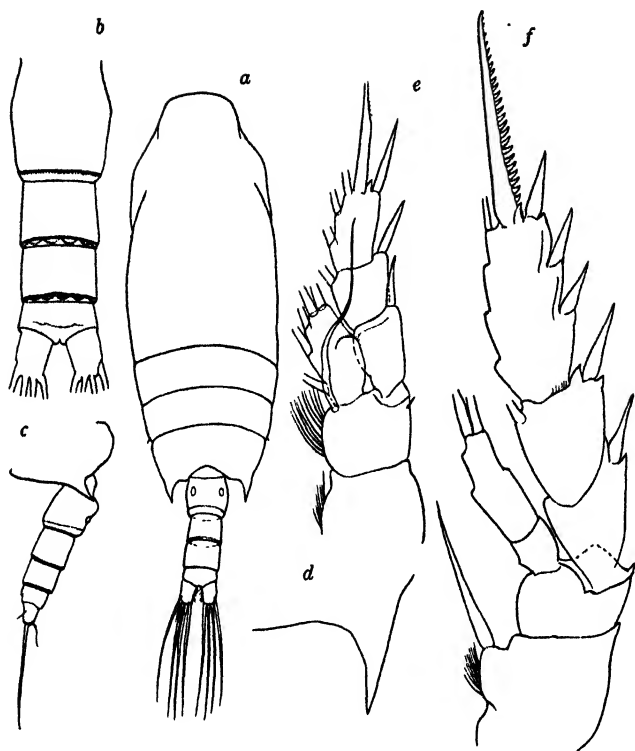
Fig. 6. *Chiridius gracilis*? Female.
a, dorsal view, ×25; b, abdomen, dorsal view, ×60;
c, abdomen, lateral view, ×30; d, spine of last thoracic
segment, ×60; e, 1st leg, ×60; f, 2nd leg, ×120.

the previous species. The terminal spine on the exopodite of the 2nd to 4th legs, has 24, 28 and 26 teeth respectively.

This specimen resembles *Ch. gracilis* Farran but the abdomen and natatory legs differ from those of "Siboga" specimen. The basal thickening on the thoracic spines given in Farran's description could not be observed.

Occurrence. Three adult females.

Distribution. West coast of Ireland, Indian Ocean, Malay Archipelago, from deep waters.

Chiridius sp.

(Fig. 7, a–e)

Remarks. The specimen is an immature male of the 5th copepodid stage. Length, 2.05 mm. The frontal margin of the cephalothorax resembles that of the female specimen of *Ch. poppei*. The combined length of the abdomen and furca is equal to 1/4 of the cephalothorax. The thoracic spines extend beyond the 1st abdominal segment. The abdomen is 4-segmented. The antennules are as in previous species. The mandible resembles that of *Ch. poppei*. In other mouth appendages, scarcely any differnce was observed. In the 1st pair of legs, the outer marginal spine on the 2nd segment of the exopodite is longer and extends beyond the base of the outer marginal spine of the 3rd segment of the exopodite. In the 2nd pair of legs, the endopodite extends to the base of the 3rd segment of the exopodite, with no trace of articulation across the 1st joint. The 5th pair of legs is 3-jointed and slightly asymmetrical. The terminal spine of the 4th pair of legs has 28 teeth.

Judging from the characters above mentioned, the specimen may be the immature male of *Ch. gracilis*.

Occurrence. One specimen in the collection.
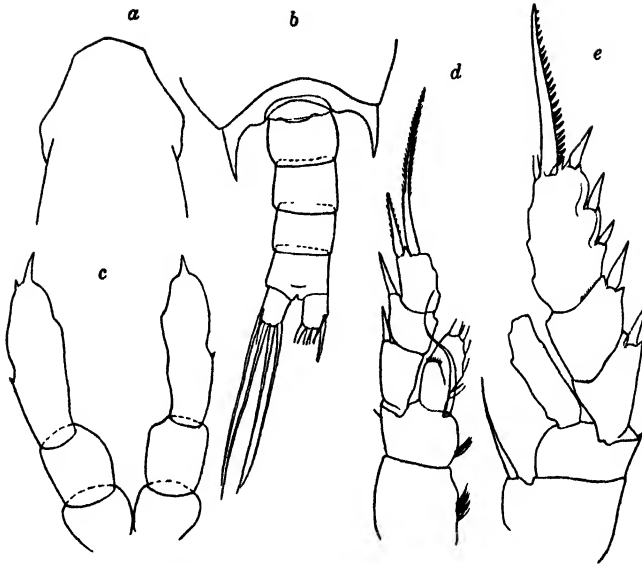
Fig. 7. *Chiridius sp.* Male, juv.
a, head, dorsal view, ×30; b, abdomen, dorsal view, ×60;
c, 5th leg, ×170; d, 1st leg, ×120; e, 2nd leg, ×120.

Genus *Gaetanus* Giesbrecht
Gaetanus minor Farran

(Fig. 8, a-d)

Gaetanus minor, A. Scott, 1909, p. 47,
   Pl. IX, Figs. 1–8
Gaetanus minor, With, 1915, p. 103,
   Pl. III, Fig. 4a.
Gaetanus minor, Farran, 1929, p. 233.
Gaetanus minor, Sewell, 1929, p. 102.

Remarks. Immature female, length, 2.00 mm. The specimen agrees fairly well with the description and figures given by A. Scott.

Occurrence. 2 immature females of the 5th copepodid stage.

Distribution. The Malay Archipelago, west coast of Ireland, Bay of Biscay, Indian Ocean, from deep waters.
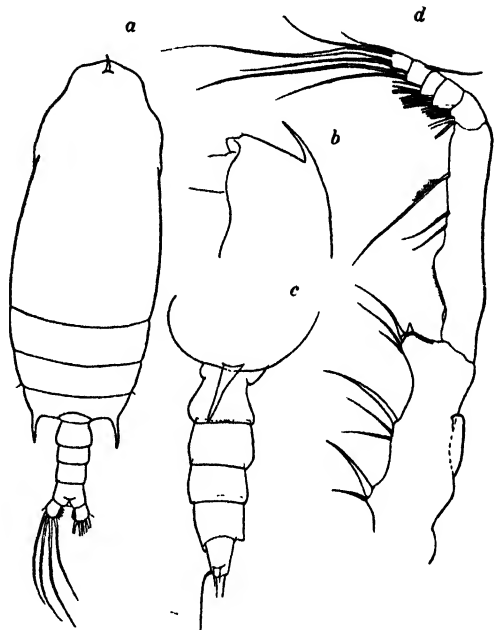
Fig. 8. *Gaetanus minor*. Female, juv.
a, dorsal view, ×30; b, head, lateral view, ×60;
c, abdomen, lateral view, ×60; d, 2nd maxillipde, ×120.

Family PHAENNIDAE
Genus *Xanthocalanus* Giesbrecht
Xanthocalanus media n. sp.

(Pl. XVII, 1-10)

Description. Female, length, 3.3 mm, cephalothorax, 2.55 mm, abdomen, 0.75 mm. Seen from above, the body appears robust and oblong ovate in outline. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are fused. The frontal margin of the head rounded. The lateral corner of the last thoracic segment extends to the middle of the genital segment and terminates in outwardly curved projection with a small point at the apex. The rostrum bifurcates and has no filament at the apical section (Pl. XVII, 4).

The abdomen is composed of 4 segments; the comparative length of abdomen and furca is 35, 25, 19, 2, 19=100. The genital segment bears on the dorsal side a rounded lamellous process and a pointed delicate spine. The ventral surface of the genital segment is not swollen. The first three segments are furnished with scattered hairs and the distal margin of the segment is fringed with hairs on the dorsal and ventral sides (Pl. XVII, 3).

The antennules are 24-jointed and extend to the distal end of the genital segment. Length of the joints of the antennules in 0.01 mm:

1	2	3	4	5	6	7	8-9	10	11	12	13	14	15	16	17	18	19
19	23	11	9	17	9	10	16	6	8	10	17	11	14	16	16	15	12

20	21	22	23	24	25
12	17	8	13	14	9

Large aesthetasks are found on the segment 2, 3, 5, 8-9, 12, 14, 19 (Pl. XVII, 5).

In the 2nd antenna, the exopodite is little longer than the endopodite.

In the mandible, the manducatory part is long and slender with rather weak teeth; the 2nd basipodite has 3 long spines; the exopodite and endopodite are subequal in length; the endopodite consists of 2 segments, of which the proximal bears 2 setae and the distal 8.

In the maxillae, the outer lobe has 7 long and 2 shorter setae; the inner lobe has 10 posterior and 4 anterior setae; the 2nd basal segment bears 4 anterior and 1 posterior setae; the endopodite has 3+3+4 setae and the exopodite 10.

The 1st maxillipedes are slightly produced posteriorly; lobe 1 has 5, lobe 2 has 3, lobe 3 has 2 setae and a vermiform filament; the lobe 4 has besides 1 usual seta a delicate bristle without spinules and a strong, slightly curved and serrated spine; the lobe 5 has a long usual seta and 2 short setae, of which one is posteriorly and naked; the strong claw-like seta is more coarsely serrated than in the lobe 4. The endopodite has 7 longer or shorter brush-shaped sensory setae as well as a long slender vermiform one (Pl. XVII, 6).

The comaparative length of the 3 main divisions of the 2nd maxillipede is 47, 45 and 32. The 1st basipodite bears, besides usual spines, one short

brush-shaped sensory seta. The 2nd basipodite is about 3 times as long as wide. The 2nd segment of the exopodite is the longest (Pl. XVII, 7).

The 1st pair of legs has 3-jointed exopodite and an unjointed endopodite; the marginal spine of the 1st and 2nd segment of the exopodite is slender and about equal in length, while the spine on the terminal segment is stouter and equal to the segment in length (Pl. XVII, 8).

The 2nd pair of legs have 3-jointed exopodite and 2-jointed endopodite; the distal segment of the endopodite is armed with coarse spines. The inner bristle on the 1st segment of the endopodite shows an abnormal structure; it is devided into branches (Pl. XVII, 9).

In the 3rd and 4th legs, both rami consist of 3 segments; the 1st segment of the endopodite of the 3rd leg has a branched abnormal bristle on the inner margin.

The 5th pair of legs resemble that of *Xanthocalanus pinguis* Farran. The anterior and posterior surfaces are furnished with groups of short spines. The division between 2nd and 3rd segment is indistinct. The inner margin of the 1st segment is irregularly denticulated (Pl. XVII, 10).

Remarks. This specimen is related to *X. pinguis* but differs from it by smaller size and spinulation on the 5th pair of legs.

Occurrence. One adult female.

Family SCOLECITHRICIDAE
Genus *Scottcalanus* Sars
Scottcalanus securifrons (T. Scott)

(Figs. 9, a–c)

Scolecithrix securifrons, Giesbrecht und Schmeil, 1898, p. 49.
Scolecithrix securifrons, A. Scott, 1909, p. 1104, Pl. XXV.
Scolecithrix securifrons, With, 1915, p. 220, Pl. VIII, Figs. 13 a–b Figs. 71 a–d.
Scolecithrix securifrons, Farran, 1929, p. 251.

Remarks. Female, length 4.00 mm, cephalothorax, 3.28 mm, abdomen, 0.72 mm. The specimen agrees quite well with Scott's description, except the following details; the posterior end of the last thoracic segment does not curve outwardly as Scott's figure; the length of the cephalothorax is more than 4-times of the combined length of the abdomen and furca; the genital segment is longer than the combined length of the next 3 segments.

Occurrence. One adult female.
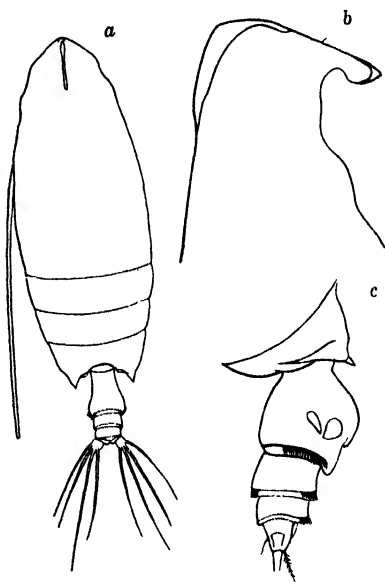
Fig. 9 *Scottcalanus securifrons*. Female. a, dorsal view, ×13; b, head, lateral view, ×30; c, abdomen, lateral view, ×30.

Distribution. Gulf of Guinea, Malay Archipelago, west coast of Ireland and the Atlantic Ocean, chiefly from deep waters.

Genus *Scolecithricella* Sars
Scolecithricella abyssalis (Giesbrecht)

(Figs. 10, a–c)

Scolecithrix abyssalis, Giesbrecht, 1892, p. 266, t. 13, Figs. 15, 40.
Scolecithrix abyssalis, Giesbrecht und Schmeil, 1898, p. 43.
Scolecithricella abyssalis, A. Scott, 1909, p. 89.
Scolecithricella abyssalis, Sars, 1920, p. 9.

Remarks. Female, length, 1.78 mm. The specimen, though considerably mutilated, fairly agrees with Giesbrecht's description. The abdomen is composed of 4 segments; the combined length of the abdomen and furca is contained about 3.7 times in the total length of the cephalothorax.

The antennules are composed of 21 joints, of which the joints 8–9–10, 20–21 and 24–25 are fused.
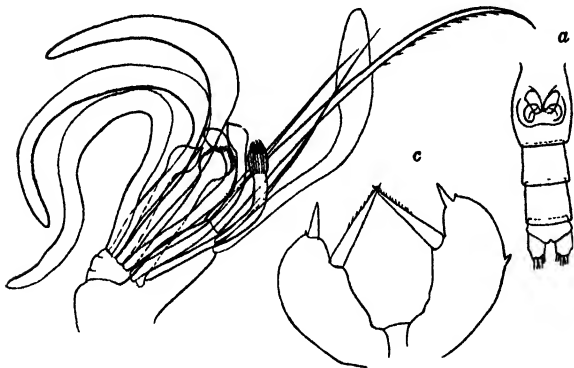
Fig. 10. *Scolecithricella abyssalis*. Female. a, abdomen, ventral view, ×60; b, distal part of 1st maxillipede, ×240; c, 5th leg, ×240.

The terminal segment of the 1st maxillipede bears 3 long vermiform filaments and 5 amalliform setae.

The 2nd maxillipede is comparatively small; the 1st basal segment carries, besides usual setae, 2 vermiform filaments and 1 amalliform seta.

The 1st segment of the exopodite has no marginal spine. The 1st basal segment of the 4th pair of legs has a small teeth on the inner distal margin.

The 5th pair of legs are similar to the figure given by Giesbrecht but the small spine on the middle of the outer margin of the segment was not observed on the left leg.

Occurrence. One adult female in the collection.

Distribution. From deep waters of Gulf of Guinea, Faroë Channel, Malay Archipelago and the Pacific Ocean.

Scolecithricella dubia (Giesbrecht)

(Fig. 11, a–e)

Scolecithrix dubia, Giesbrecht, 1892, p. 266, t. 13, Fig. 29.
Scolecithrix dubia, Giesbrecht und Schmeil, 1898, p. 44.
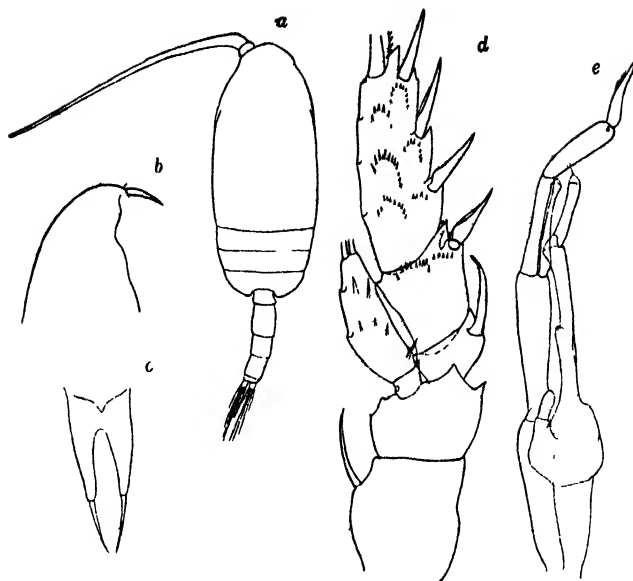
Fig. 11. *Scolecithricella dubia*. Male.
a, dorsal view, ×30; b, head, lateral view, ×60;
c, rostrum, ×240; d, 2nd leg, ×170; e, 5th leg, ×170.

Remarks. Male, length, 1.48 mm. The body is oblong ovate in dorsal aspect. The head is fused with the 1st thoracic segment; the 4th and 5th thoracic segments are completely fused. Seen from the side, the head is obliquely rounded and produced into moderately stout rostrum. The last thoracic segment is evenly rounded. The rostrum is composed of a long divergent basal part, to which are attached rather short filaments.

The abdomen is composed of 4 segments; the combined length of the abdomen and furca is contained 2.6 times in the length of the cephalothorax.

The right antennule is 19-jointed, of which the joint 8–12, 20–21 and 24–25 are fused. The left antennule is 20-jointed; the 20 and 21 are separated. They reach about to the end of the genital segment.

The 2nd antennae and other mouth appendages resemble those of other members of the genus.

The 1st pair of legs have 3-jointed exopodite and 2-jointed endopodite; the 1st segment of the exopodite has no marginal spine. The 2nd pair of legs have 3-jointed exopodite and 2-jointed endopodite; the 1st segment of the exopodite has long curved marginal spine.

The 5th pair of legs closely agree with the figure given by Giesbrecht.

Occurrence. One adult male.

Distribution. This species has been recorded from the Mediterranean and Gulf of Guinea.

Genus *Scaphocalanus* Sars
Scaphocalanus minuta n. sp.

(Pl. XVIII, 1-11)

Description. Male, length, 2.21 mm, cephalothorax, 1.48 mm, abdomen, 0.73 mm. Viewed from the dorsal, the cephalothorax is oblong ovate and contracted in front; the head is fused with the 1st thoracic segment. The 4th and 5th thoracic segments are incompletely separated. The last thoracic segment is bluntly rounded in the lateral aspect (Pl. XVIII, 1, 2, 3). The rostrum is based on a knob produced from the anterior margin of the forehead; when viewed from the lateral the rostral filaments are slender (Pl. XVIII, 11).

The abdomen is composed of 5 segments; the length of the joints of the abdomen and furca in 0.01 mm is 5.4, 27, 14, 18, 2 and 5.4 respectively. The segments 2-4 inclusive are fringed with fine spines on the distal margin (Pl. XVIII, 3).

The antennules are composed of 19 joints and extend to the end of the 3rd thoracic segment; the antennules considerably bent posteriorly between the segments 14 and 15; the segments 1-2, 8-12 are fused; the segments 20-21 are fused on the right side; the segments 24-25 are completely fused on both sides (Pl. XVIII, 4).

The 1st basal segment of the 2nd antenna has a row of hairs on the posterior surface; the exopodite is about 1.3-times as long as the endopodite (Pl. XVIII, 5).

In the mandible, the 2nd basipodite is wider than its length (Pl. XVIII, 6, 7).

The other mouth appendages are less developed.

The 1st pair of legs consists of 3-jointed exopodite and 1-jointed endopodite; the 1st segment of the exopodite bears no marginal spine (Pl. XVIII, 8).

The 2nd pair of legs has 3-jointed exopodite and 2-jointed endopodite. The 2nd segment of the endopodite bears spines on the posterior surface (Pl. XVIII, 9).

The 3rd and 4th legs were damaged in the present specimen.

The 5th pair of legs is like that of *Scaphocalanus magnus* T. Scott; the terminal attenuated part of the right endopodite is articulated as With's figure but it does not reach to the distal margin of the exopodite (Pl. XVIII, 10).

Remarks. The specimen has the general resemblance to *S. magnus* but it can be separated by the smaller size and by the structure of the 5th pair of legs.

Occurrence. One adult male.

Scaphocalanus gracilicauda n. sp.

(Figs. 12, a-f)

Description. Male, length, 1.75 mm, cephalothorax, 1.18 mm, abdomen,
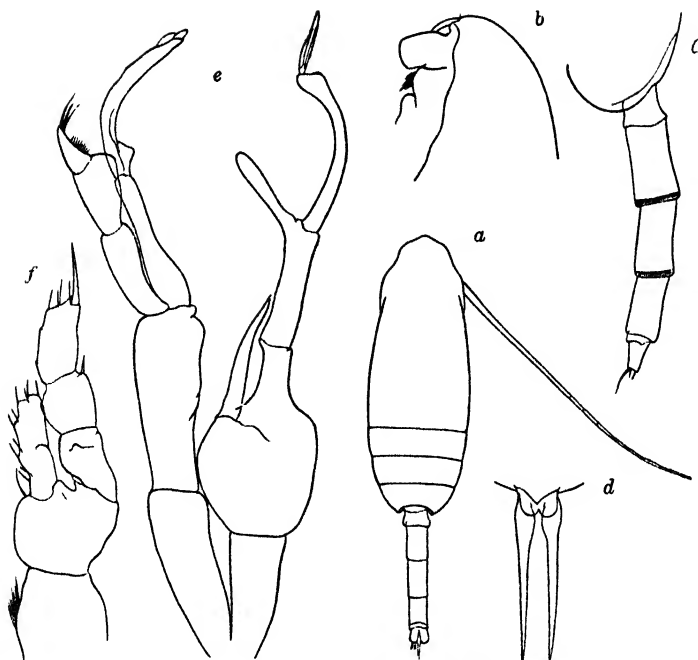
Fig. 12. *Scaphocalanus gracilicauda* n. sp. Male.
a, dorsal view, ×30; b, head, lateral view, ×60;
c, abdomen, lateral view, ×60; d, rostrum, ×240;
e, 5th leg, ×170; f, 1st leg×170.

0.57 mm. The body appears less robust than the foregoing species. The last thoracic segment is bluntly rounded in lateral view. The rostral filaments are slender.

The abdomen is slender and composed of 5 segments. The combined length of the abdomen and furca is contained nearly 2 times in the total length of the cephalothorax. The length of the segments and furca in 0.01 mm 6.8, 15.6, 14.6, 13.8, 9 and 6 respectively. The 2nd and 3rd segments are striated on the distal margin.

The antennules are composed of 20 joints and extend to the end of the 3rd abdominal segment; the segment 8-9, 10–12 are fused; the segment 20–21 are separated on the right side; the segment 24–25 are completely fused.

The 2nd antennae and other mouth appendages are like those of the foregoing species.

The swimming legs, 1st to 4th, resemble to those of the foregoing species.

The styliform endopodite of the right leg is not articulated and reaches to 1/3 of the 1st segment of the exopodite. The exopodite has moderately long blunt process on the inner distal margin. The middle segment of the left exopodite is swollen on the inner margin.

Remarks. The species is readily separated from the other member of the genus by the slender abdomen and peculiar form of the 5th leg.

Occurrence. One adult male.

Family THARYBIDAE
Genus *Paratharybis* n. gen.

The family *Tharybidae* was established by Sars in 1903 in his " Crustacea of Norway, Vol. IV, Copepoda Calanoida". The family comprises, as far as I know, only one genus *Tharybis*. The new genus *Paratharybis*, though evidently referable to the present family, shows so many pronounced differances in the female from the genus *Thaybis* that it can not be properly be included in this genus.

Definition. The head is separtated from the 1st thoracic segment. The 4th and 5th thoracic segments are incompletely separated. The rostrum is composed of vermiform filaments attached to a peculiar basal portion. The antennules are 24-jointed. The 2nd antennae, mandibles and natatory legs are similar in the structure to those of the genus *Tharybis*. The 5th pair of legs are 3-jointed on both sides.

The articulation of the cephalothorax, the peculiar form of the rostrum and the structure of the maxillae and 1st maxillipedes, are all different from those of the genus *Tharybis*.

One species belonging to this genus was found in the collection.

Paratharybis frontalis n. sp.
(Fig. 13, a–c and Pl. XIX, 1–13)

Description. Female, length 2.21 mm, cephalothorax, 1.58 mm, abdomen, 0.64 mm. The cephalothorax appears oblong ovate in dorsal view. The head separates from the 1st thoracic segment. The 4th and 5th thoracic segments are incompletely separated. The frontal margin of the head is boldly arched in lateral view. The last thoracic segment is asymmetrical and obtusely triangular (Figs. 13; a, b, c). The wide basal part of the rostrum is bifurcated and, when viewed from the side, has 2 protuberances; the one is with a pointed end and the other is knob-like. The rostral filament is attached between those protuberances and looks like " Aesthetask " of the antennule (Pl. XIX, 1, 2, 3).

The abdomen is composed of 4 segments. The length of the segments and furca in 0.01 mm is 22, 16.5, 16.5, 0.9, and 11 respectively. The genital segment is swollen ventrally; the left side of the segment has low blunt process on the ventral surface. The furcal rami are 2 times as long as wide and con-tracted at the proximal part. Among the furcal setae, the outer one is the stoutest. The segment 1 to 3 are furnished with small serrated cuticulous plates on the distal margin (Figs. 13, b, c).

The antennules are 24-jointed and extend to the end of the last thoracic segment. The length of the segments in 0.01 mm :

1	2	4	5	6	7	8–9	10	11	12	13	14	15	16	17
9.2	13.7	5.9	3.7	3.7	4.6	8.3	4.6	5.1	5.9	6.9	7.4	8.3	10.0	10.0

$$\begin{bmatrix} 18 & 19 & 20 & 21 & 22 & 23 & 24 & 25 \\ 9.3 & 9.2 & 9.2 & 8.3 & 8.7 & 9.2 & 10.0 & 5.6 \end{bmatrix}$$

Aesthetask is found on the segment 2, 3, 5, 7, 8-9, 12, 14, 19 and 25 (Pl. XIX, 4).

The 1st basal segment of the 2nd antennae has rows of longer and shorter hairs on the basal portion; the distal seta was not observed. The 7-jointed exopodite is 1.6 time as long as the endopodite; the distal margin bears a single seta on the 3rd to 7th segment and 3 setae on the apex. The endopodite is composed of 2 segments, of which the 1st has 2 marginal setae, the 2nd has 8+6 setae at the distal margin (Pl. XIX, 5).

The manducatory part of the mandible is rather long; the 1st marginal tooth is very stout and the remaining teeth are converted into strong spines. The 2nd basipodite is broad and bears 2 stout setae on the inner margin near the proximal part. The endopodite consists of 2 segments, the 1st of which bears 2 setae and the 2nd 9 setae (Pl. XIX, 6).

Fig. 13. *Paratharybis frontalis*, n. sp. Female. a, dorsal view, ×30; b, abdomen, dorsal view, ×60; c, abdomen, lateral view, ×60.

The maxilla has very robust basipodite 1. The outer lobe 1 bears 6 setae; the inner lobe 1 is exceedingly large, bears 12 setae; the inner lobe 2 has 2, the inner lobe 3 has 4 setae. Basipodite 2 is rather small and carries 4 anterior setae. The endopodite (1-2-3) has 2+2+2 setae. The exopodite has only 2 setae and bluntly rounded lamellous process at the distal margin (Pl. XIX, 7).

The lobes of the 1st maxillipedes, 1st to 5th, have 3 setae respectively. One of the setae on the 5th lobe is stout and rather straight; no spinule was observed along the seta. The endopodite bears 5 aesthetask-like sensory setae (Pl. XIX, 8).

In the 2nd maxillipedes, the 1st basipodite bears 1, 2 and 3 setae on the

lobe 1 to 3 respectively; the last lobe has 2 setae and 1 small rounded process beset with fine hairs. The 2nd basipodite bears only 1 small seta about the middle of the anterior margin; the proximal part of the segment is furnished with fine spines. The 2nd segment of the endopodite is 2 times as. long as the 1st segment and about 3 times as long as wide. The setae on the segments are feeble (Pl. XIX, 9).

The basal segments of the 1st pair of legs are furnished with hairs on the inner margin. The exopodite consists of 3 segments. Of these, the 1st carries a short outer marginal spine extending to the middle of the 2nd; the inner border of the segment is beset with fine hairs but bears no seta. The 2nd segment carries marginal spine that extends to 2/3 of the 3rd segment of the exopodite. The marginal spine on the 3rd segment is about $1\frac{1}{2}$ times as long as the segment; the outer border of the segment is furnished with fine hairs and the inner border bears 3 setae. The terminal seta is coarsely denticulated; the number of the teeth is about 15. All the marginal spines are slightly serrated. The endopodite consists of a single segment and reaches to the base of the inner marginal seta of the 2nd segment of the exopodite; the outer margin carries rounded swelling which is beset with fine spines; the segment is furnished with 5 setae (Pl. XIX, 10).

The 1st basipodite of the 2nd pair of legs bears fine hairs and a single plumose seta. The segments of the exopodite are rather broad. The outer marginal spine on the 2nd segment of the exopodite is the longest and reaches to about the middle of the 3rd segment; the outer marginal tooth near the base of the spine is not pointed but narrowly rounded. The 3rd segment of the exopodite bears 3 marginal spines; the inner margin bears 4 setae. The terminal seta is finely denticulated; the number of the teeth is about 41. The endopodite consists of 2 segments and reaches to the base of the 3rd segment of the exopodite; endopodite 1 bears single seta; endopodite 2 bears 5 setae (Pl. XIX, 11).

The 3rd and 4th pair of legs are composed of 3-jointed exopodite and endopodite and are of the similar structure as in the 2nd pair of legs.

The 5th pair of legs is asymmetrical and is composed of 2 free segments attached to the basal part; the slender right leg is about twice as long as the left. The last segment of both legs is furnished with 3 distal spines and 1 marginal spine near the 1/3 portion from the distal end of the segment.

Occurrence. One adult female in the collection.

<div align="center">

Family METRIDIDAE

Genus *Metridia* Boeck

Metridia venusta Giesbrecht

(Figs. 14, a–c)

</div>

Metridia venusta, Giesbrecht 1892, p. 340, t. 33.
Metridia venusta, Giesbrecht und Schmeil, 1898, p. 107.
Metridia venusta, Scott 1909, p. 122.

Remarks. The specimen are immature female of copepodid stage V. Length, 2.40–2.43 mm. They are in the main features similar to the adult female. The abdomen is 4-segmented; the 4th segment is the longest. In the 5th pair of legs, a distinct limitation is observed in the middle of the segment.

Occurrence. Two immature females in the collection.

Distribution. This species has been recorded from deep waters of the Pacific and Malay Archipelago.

Genus *Pleuromamma* Giesbrecht

Pleuromamma gracilis (Claus)

(Figs. 15, a–b; 16, a–b)

Pleuromma gracile, Claus, 1863, p. 197, t. 5, Figs. 7–11.

Pleuromma gracile, Giesbrecht, 1892, p. 347, t. 32, 33.

Pleuromamma gracilis, Giesbrecht und Schmeil, 1898, p. 110.

Pleuromamma gracilis, Wolfenden, 1905, p. 1012.

Pleuromamma gracilis, Esterly, 1905, p. 175, Fig. 33.

Pleuramamma gracilis, Scott, 1909, p. 123.

Pleuromamma gracilis, Farran, 1929, p. 260, Fig. 23a, 24a

Fig. 14. *Metridia venusta*. Female. a. dorsal view, ×30; b, proximal part of exopodite and endopodite of 2nd leg, ×240; c, 5th leg, ×240.

Remarks. Female, length 1.72–1.86 mm. Two forms are observed in the collection; the one is *Pl. gracilis* (Claus) and the other *Pl. Piseki* Farran. There are distinct differences between these two forms as Farran states in his Report of "Terra Nova" Expedition e. i., difference in size, genital segment, the form of the anal segment and the structure in the 5th pair of legs. I will not attempt here to make any conclusion because of unsufficient material. I give only some figures of the two forms.

Occurrence. Two adult female of *Pl. gracilis* and eight specimens of *Pl. Piseki* (length, 2.09–2.15 mm) were found in the collection.

Distribution. The Pacific, Atlantic, Indian Ocean and Mediterranean Sea, both from the surface and deep waters.

Fig. 15. *Pleuromamma gracilis*. Female. a, abdomen, ventral view, ×60; b, 5th leg, ×120;
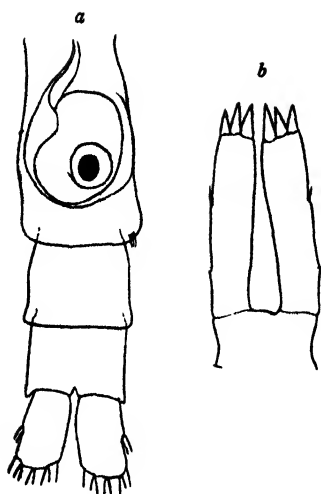
Fig. 16. *Pleuromamma Piseki*. Female.
a, abdomen, ventral view, ×60,
b, 5th legs, ×120.

Fig. 17. *Heterorhabdus papilliger*. Male, juv.
a, head, lateral, ×60; b, 5th legs, ×90.

Family HETERORHABDIDAE
Genus *Heterorhabdus* Giesbrecht
Heterorhabdus papilliger (Claus)

(Figs. 17, a–b)

Heterochaeta papilligera, Claus, 1863, p. 182, t. 32.
Heterochaeta papilligera, Giesbrecht, 1892, p. 313, t. 20, 39.
Heterorhabdus papilliger, Giesbrecht und Schmeil, 1898, p. 114.
Heterorhabdus papilliger, A. Scott, 1909, p. 131.
Heterorhabdus papilleger, Farran, 1929, p. 265.

Remarks. Male, length 2.38 mm. This immature specimen appears too large in size but the 2nd maxillipede and other appendages agree well with Giesbrecht's figures. In the 5th pair of legs, the exopodite consists of 2 segments.

Occurrence. One immature male.

Distribution. The Pacific, Atlantic and Malay Archipelago, both from the surface and deep waters.

Family AUGAPTILIDAE
Genus *Augaptilus* Giesbrecht
Augaptilus palumboi (Claus)

(Fig. 18, a–f)

Augaptilus palumboi, Giesbrecht, 1892. p. 400, t. 27, 28, 39.
Augaptilus palumboi, Giesbrecht und Schmeil, 1898, p. 122.
Augaptilus palumboi, A. Scott, 1909, p. 137.

Remarks. Length, immature female, 1.91 mm, male, 1.87 mm. The specimen agrees quite well with the description and figures given by Giesbrecht. The immature male specimen resembles female in general appearance. The 5th legs has 3-segmented exopodite and endopodite.

Occurrence. A single immature female and a male.

Distribution. The Pecific, Malay Archipelago and North Atlantic.

Fig. 18. *Augaptilus palumboi.*
Female.   a. dorsal view, ×30; b, head, lateral view, ×60; c, 5th leg ×120.
d, mandible blade, ×240.
Male, juv.   e, 1st leg, ×170; f, 5th legs, ×120.
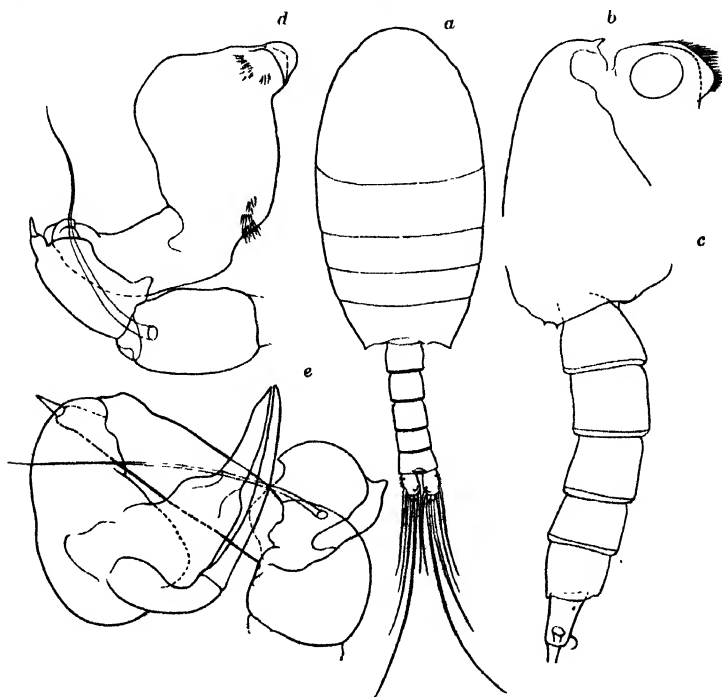
Fig. 19. *Phyllopus helgae.*   Male.
a. dorsal view, ×25; b, head, lateral view, ×60; c, abdomen, lateral
view, ×60; d, 5th leg, right side, ×120; e, 5th leg, left side, ×120.

Family ARIETELLIDAE
Genus *Phyllopus* Brady
Phyllopus helgae Farran

(Fig. 19, a–e)

Phyllopus helage, Scott, 1909, p. 148, Pl. XLVI, Figs. 7–14.

Remarks. Male, length, 2.03 mm. The specimen agrees closely with the description and figures given by Scott except the differnce in size. The cephalothorax is oblong ovate and robust in dorsal view. The termination of the last thoracic segment is symmetrical. The apex are bluntly truncate with 2 very minute points at each extremity in lateral view. The abdomen is contained about 1.6 times in the length of the cephalothorax. The 1st 3 segments of the abdomen are nearly equal in length and the last 2 segments are also of equal length. The left antennule is 24-jointed and extends to the 3rd segment of the abdomen; the right antennule is 20-jointed. The last joint of the exopodite of the left 5th leg is elongate and pointed at the apex and has a long curved spine on the outer distal half of the joint.

Occurrence. One adult male.

Distribution. From deep waters of the North Atlantic and the Malay Archipelago.

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Plate XVII

Xanthocalanus media n. sp.

1. Female, dorsal view. ×23
2. Female, head, lateral view. ×40
3. Female, abdomen, lateral view. ×80
4. Female, rostrum. ×230
5. Female, antennule. ×120
6. Female, distal part of 1st maxillipede. ×160
7. Female, 2nd maxillipede. ×80
8. Female, 1st leg. ×160
9. Female, 2nd leg. ×80
10. Female, 5th leg. ×160

Plate XVIII

Scaphocalanus minuta n. sp.

1. Male, dorsal view. ×40
2. Male, head, lateral view. ×80
3. Male, abdomen, lateral view. ×80
4. Male, antennule, left side. ×80
5. Male, 2nd antenna. ×160
6. Male, mandible. ×160
7. Male, mandible blade. ×320
8. Male, 1st leg. ×230
9. Male, 2nd leg. ×230
10. Male, 5th leg. ×160
11. Male, rostrum. ×470

Plate XIX

Paratharybis frontalis n. sp.

1. Female, head, lateral view. ×60
2. Female, anterior view. ×170
3. Female, antero-lateral view. 170
4. Female, antennule. ×60
5. Female, 2nd antenna, ×120 and 1st basipodite. ×40
6. Female, mandible. ×240
7. Female, maxilla. ×240
8. Female, 1st maxillipede. ×240
9. Female, 2nd maxillipede. ×120
10. Female, 1st leg. ×120
11. Female, 2nd leg. ×120
12. Female, 3rd leg. ×120
13. Female, 5th leg. ×240
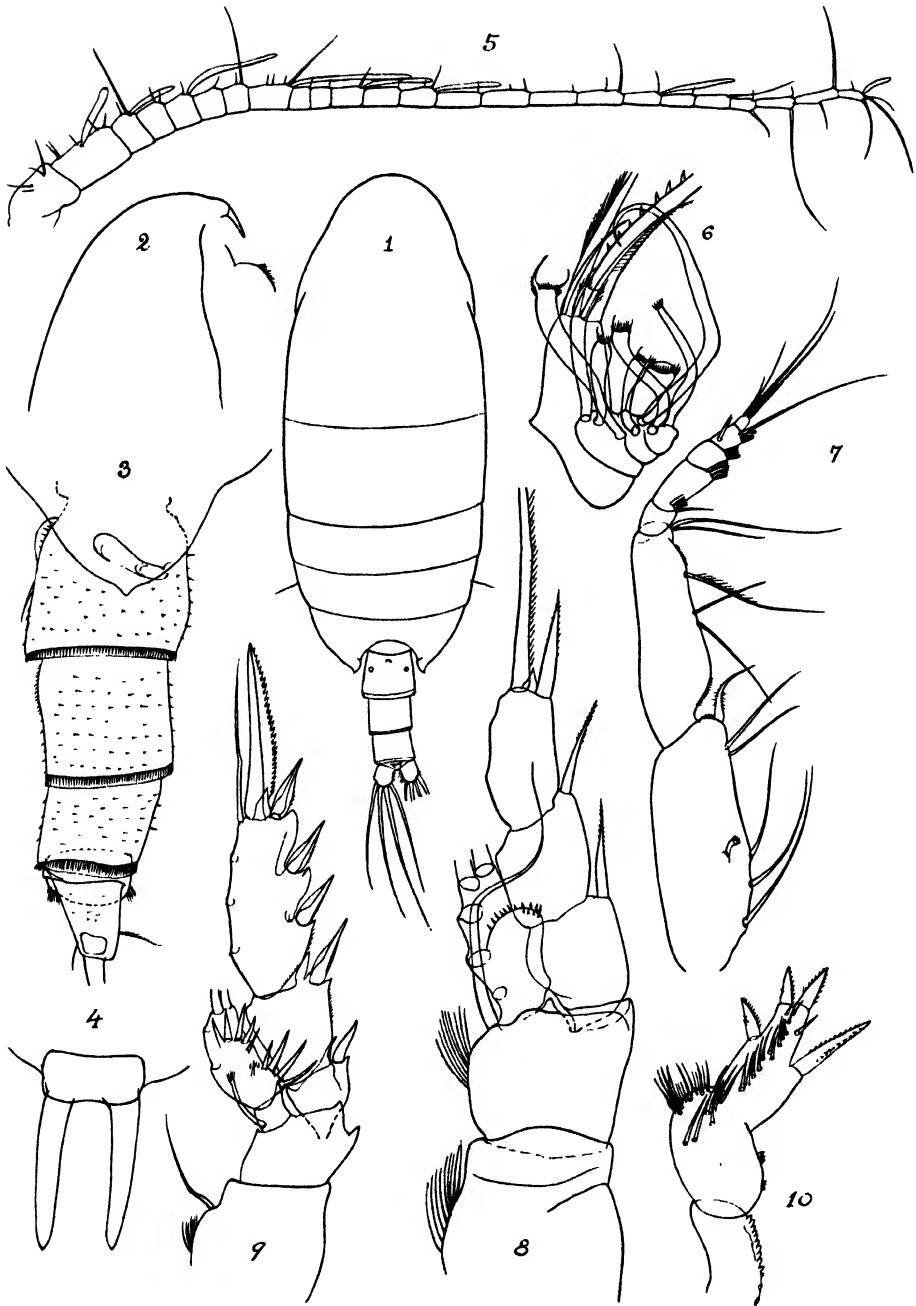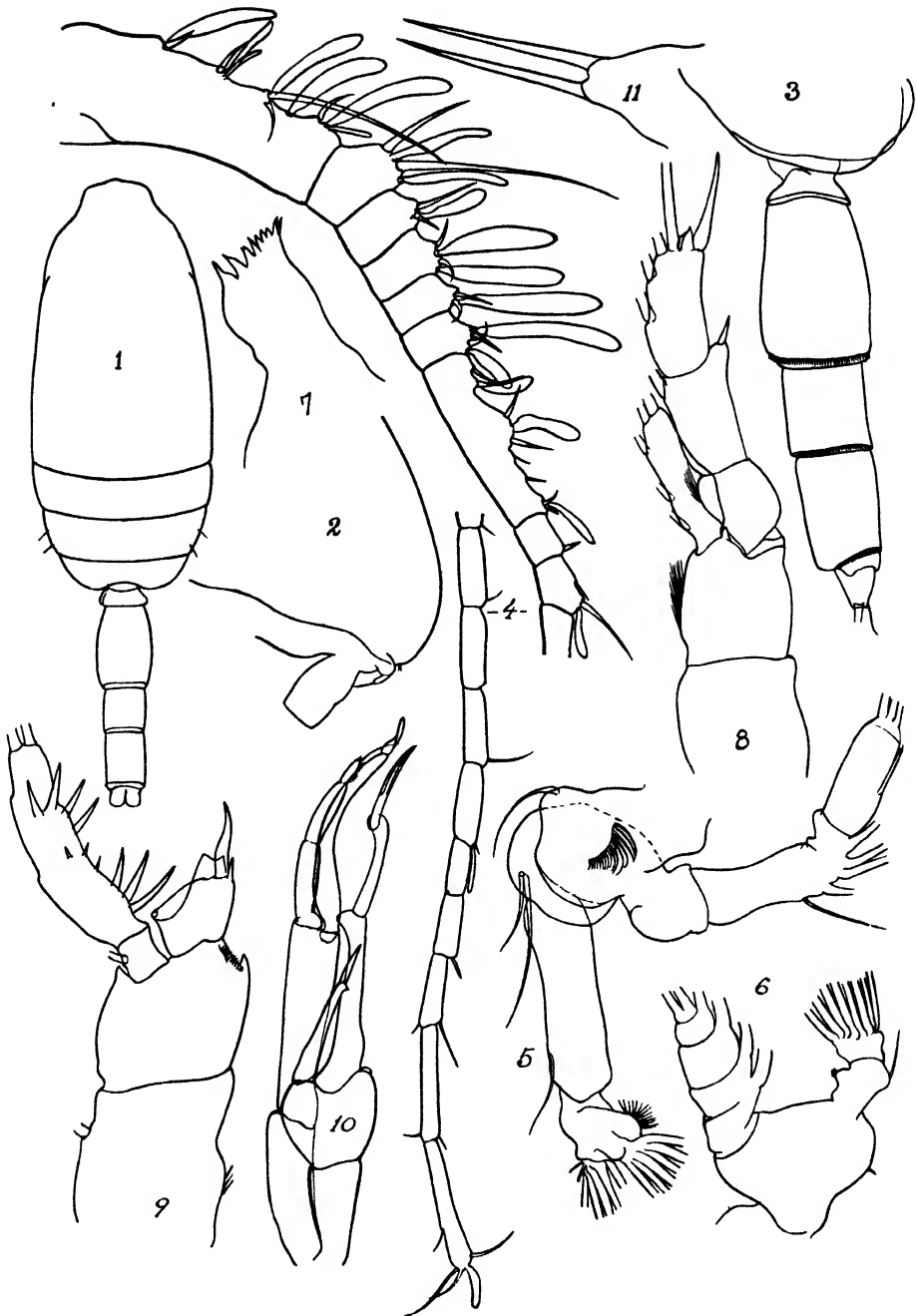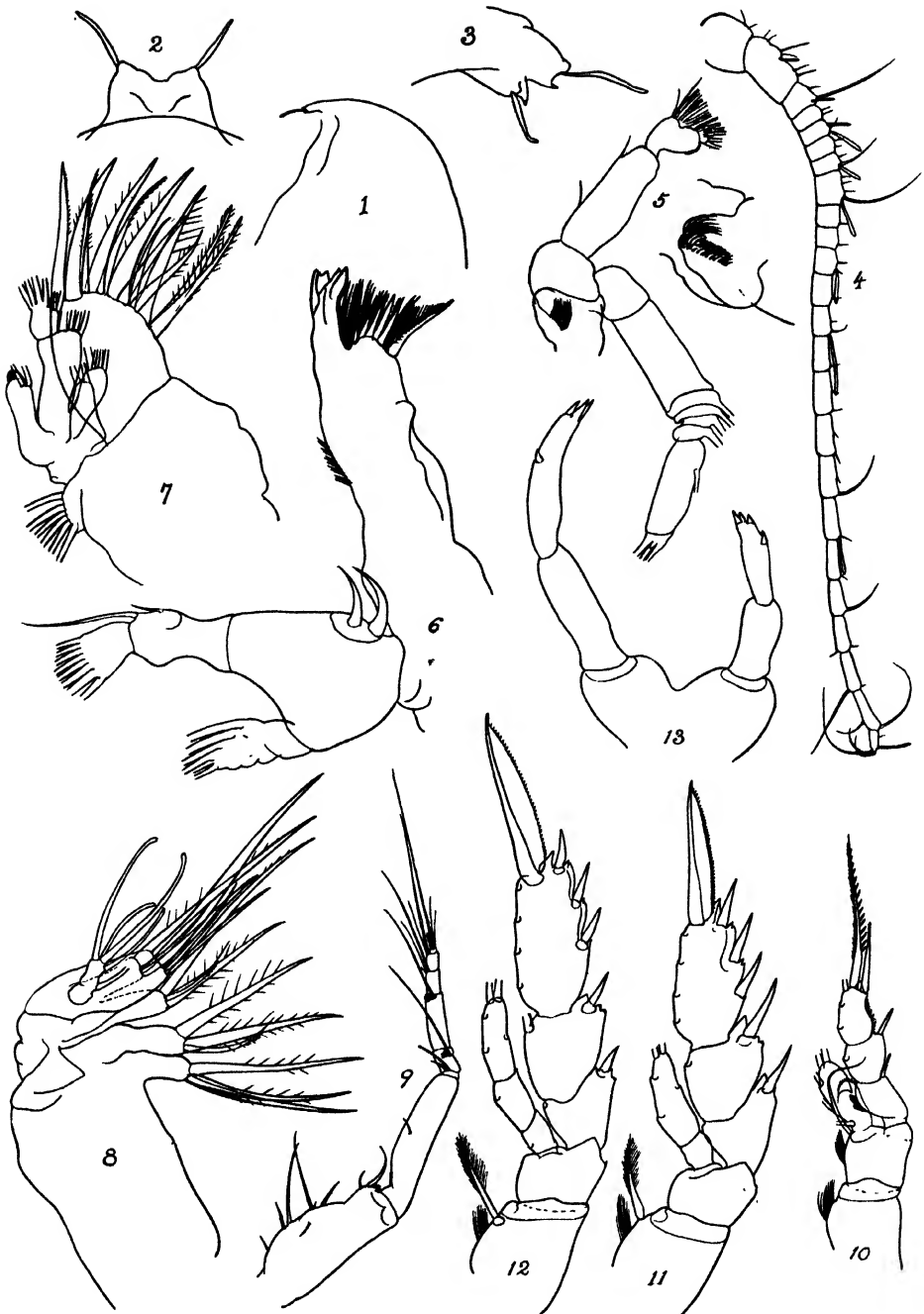
14. Reducing Power of the Body Fluid of the Silkworm

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(With 7 Text-figures and 12 Tables)

CONTENTS

INTRODUCTION

During the studies of the metamorphosis of a silkworm, the writer's attention was drawn to the fact that the reducing power of the body fluid of this insect shows a striking rise before ecdysis. This fact has already been reported by Demjanowski and Prokoffjeva (1935) who studied the change of the value of the reducing power in the course of the development of a silkworm. The keen interest in the analysis of ecdysis and metamorphosis of the insect led me to attempt a research in the same field.

The reducing power of the body fluid was measured from the beginning of the fourth stage till the adult by means of several modifications of the Hagedorn Jensen method. One of the characteristic points which have been found in the present research may be the success of the analysis of the total reducing value into several fractions. By means of this analysis, some natures of the reducing substances which play an important rôle in relation to the

striking rise of the reducing power have been elucidated. The total reducing power was at first analysed into two fractions by means of so-called hot and cold method. This is a modification of that applied first by Gulland and Peters (1930) to their investigation of the reducing value of the pigeon blood. In the meanwhile, I found a peculiar nature of the body fluid i. e., the reducing power decreases spontaneously, when it is exposed to the air, — a fact which gives us a second way to analyse the reducing power into two fractions. Furthermore, in the determination of the reducing value, tungstic acid was employed for deproteinization instead of zinc hydroxide which is usually used in the Hagedorn Jensen procedure. Next, by use of this filtrate, fermentation experiment was carried out. Besides these, hydrolysis experiment was also tried. This revealed that there was a great deal of increase in the reducing power of the body fluid on hydrolysis, and the major fraction of this increase disappeared on fermentation. Finally, measurements were carried out regarding uric acid, as it is the only substance, the nature of which may be said to be practically clear at present.

Before proceeding further, it is necessary to give definitions to some technical terms here used for the developmental stages of a silkworm. " Sleep " means the quiescent state of a worm without feeding near the end of each larval stage. A period, during which the sleep continues, is called " sleeping period ". " Stage " is used, in general, for a period between two ecdyses ; for instance, the fifth larval stage, the pupal stage and so on. " The feeding period " means a period of a larval stage, from the end of ecdysis until the beginning of the sleep. During this period a silkworm devours the mulberry leaves. " Ripen " means that a larva becomes prepared to cocoon.

MATERIAL AND METHOD

Materials have been obtained from various races, E. 16, Kurosima, J. 107, Syô-kô yellow, Ringetu, Daizô and others. Among these, J. 107 and Syô-kô yellow were mostly employed.

Ideally speaking, it is desirable to begin the measurements of the reducing powers at the very beginning of the first larval stage, and indeed Demjanowski and Prokoffjeva studied from the first larval stage. But in my opinion, it will not be too late to start at the fourth larval stage, as the main object of the study is related to ecdysis and metamorphosis. In the present work, all the measurements were started at the beginning of the fourth stage.

For the collection of the body fluid, somewhat special cares must be taken for different stages, because of the different features of the body structure. As to larvae, general procedure was as follows : Keep a worm bent double in such a way as the dorsal side was folded within. Then the legs were cut off with scisors. The body fluid dropping from the wounds was collected in a test-tube. For the collection of the body fluid of pupae, the following method was found to be the best : A pupa kept between fingers is dissected with scisors along nearly the whole length of the dorsal line, and the body is pressed

moderately with fingers taking much care not to let the contents of the alimentary canal burst. In this condition, the fluid dribbling drop by drop is collected. In this case, it is difficult to obtain the body fluid without being contaminated with some other tissue elements than the body fluid proper, as the histolysis proceeds so actively within the pupal body. Especially the fragments of the adipose tissue easily flow out together. This tendency is especially great in such pupae which pupated two or three days beforehand. Therefore the fluid of the early pupae was centrifuged prior to use. Regarding moths, it was found most convenient to prick the intersegmental part with a sharp needle. The collection from males was a hard work, as the quantity of the fluid of the male is very scanty.

Much care must be taken of the spontaneous change in the nature of the body fluid, which occurs during the process of collection. As is well known, the body fluid of insects undergoes a peculiar change called melanosis, when it is taken out of the body and is exposed to the air: the body fluid soon begins to exhibit a reddish brown colour, which deepens gradually and eventually the whole fluid becomes blackish brown. Parallel to the progress of the melanosis, there occurs an important change in the nature of the body fluid, — the decrease of the reducing power. In order to prevent this decrease as simply and as completely as possible, the collection of the body fluid was manipulated in a test-tube kept in ice water. Test measurements, carried out at intervals of half an hour, made it clear that the fluid thus cooled did not show any decrease of the reducing power within at least two hours. The only drawback of this procedure is that the volume measurement of the body fluid must be undertaken at a low temperature about 0°C, far lower than the temperature in an ordinary laboratory, where the rest of the procedure was to be continued. But for present, the removal of this drawback is incompatible with the suppression of the decrease of the reducing power which is more important. Practically this defect is negligible, if each series of measurements are carried out under the same treatment.

REDUCING POWER AS MEASURED WITH THE ZINC HYDROXIDE FILTRATE

In this section, I shall describe the results of various determinations undertaken with the zinc hydroxide filtrate. The total reducing power will be explained first, then the cold and the hot value and finally the spontaneous decrease of the reducing power in the air will be described.

TOTAL REDUCING POWER: From the body fluid which is kept cold as stated above, pipette 0.1 ml accurately and mix well with a deproteinizer, — a mixture of 1 ml 0.1 N sodium hydroxide and 5 ml 0.45% zinc sulphate solution prepared in a test-tube. Put the test-tube into a boiling water bath and deproteinize after 3 minutes. To the filtrate add 2 ml alkaline potassium ferricyanide solution and heat in a boiling water bath for 15 minutes. Cool and add 3 ml of the potassium iodide-zinc sulphate solution and 2 ml of 3% acetic acid solution. Titrate with 0.005 N sodium thiosulphate. This is the ordinary

procedure of Hagedorn Jensen method, and the value thus obtained is called, in the present paper, the total reducing value.

The results will be found in Table 1 and Fig. 1, both of which give the data from the summer breed of Syô-kô yellow. In examining them, it is found that the reducing power changes with the developmental stage pursuing a course in the following manner: At the early period of the fourth stage, the value is at a low level, about 90 mg/dl in terms of glucose, then it increases gradually until the end of the stage, but after entering the fourth sleep, it increases noticeably and at the end of the sleep, just before the ecdysis, the power is found to show such a high value as 200 mg/dl; after the ecdysis, however, the power decreases very promptly and even such an individual as in the course of ecdysis shows a value far lower than those just before ecdysis. How long it takes after ecdysis for the reducing power to fall from a high value down to a low level has not yet been made clear, but anyhow after one or two days from ecdysis the value comes to nearly the same level as it was at the beginning of the fourth stage, e. i., about 80 mg/dl in the case of Table 1. Starting from this low level, the reducing power at the fifth stage follows a course similar to that of the previous stage attaining a value of about

Table 1

Reducing powers as measured with the zinc hydroxide filtrate. Amounts in terms of glucose mg/dl. Material: Syô-kô yellow.

Date		Stage	Boiled immediately						Boiled after 24 hours						Labile value			
			Total value		Cold value		Hot value		Total value		Cold value		Hot value		Cold value		Hot value	
			♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
August	9	Fourth stage, first day	91		31		60		82		21		61		10		-1	
	11		104		50		54		71		23		48		27		6	
	12	Fourth sleep	134		88		46		70		25		45		63		1	
	12	Just before ecdysis	208		163		45		71		29		42		134		3	
	13	Fifth stage	106		50		56		79		24		55		26		1	
	15		92	85	34	31	58	54	76	72	24	20	52	52	10	11	6	2
	18		88	78	39	36	49	42	68	68	23	25	45	43	16	11	4	-1
	20	Ripening	111	90	63	52	48	38	72	66	25	24	47	42	38	28	1	-4
	21		113	102	61	63	52	39	67	67	24	25	43	42	37	38	9	-3
	22	Just before pupation	232	222	180	181	52	41	94	92	42	42	52	50	138	139	0	-9
	22	Just after pupation	150	144	92	91	58	53	84	74	34	39	50	35	58	52	0	1
	23	Pupal stage	146	141	97	92	49	49	93	93	46	43	47	50	51	49	2	-1
	26		134	131	78	76	56	55	92	100	38	47	54	45	40	29	2	-10
	29		145	132	88	75	57	57	114	117	60	56	54	61	28	19	3	-4
September	1		139	124	90	72	49	52	102	89	52	50	50	39	38	22	-1	13
	2	Adult	115	108	66	56	49	52	63	52	20	15	43	37	46	41	6	5
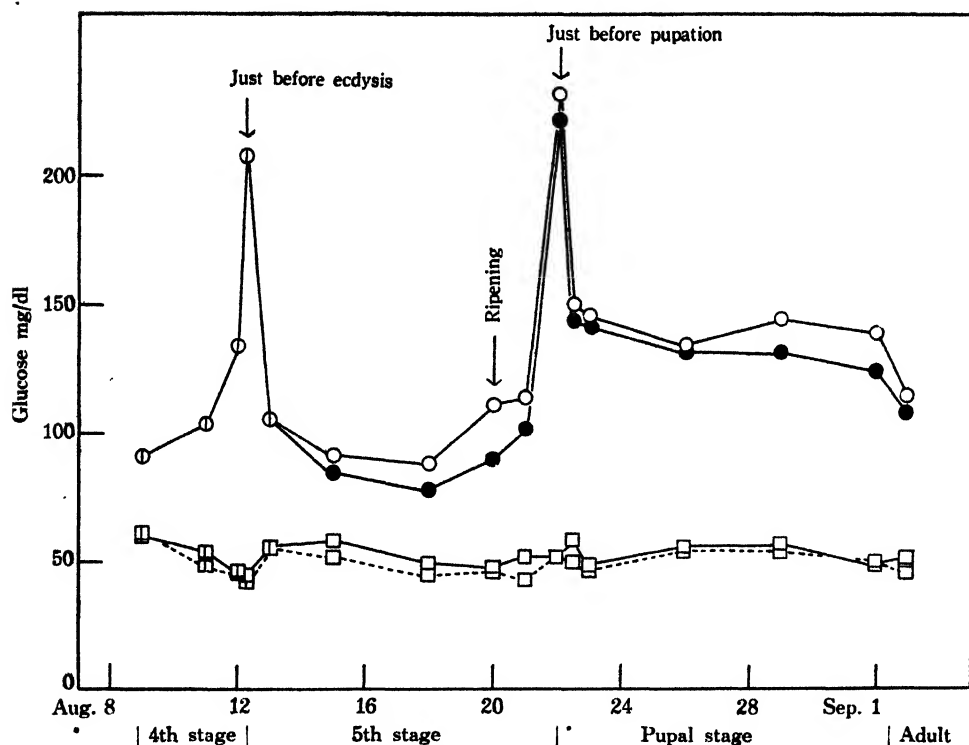
Fig. 1. Course of the reducing powers as measured with the zinc hydroxide filtrate. —①- total value ♀♂; —○— total value ♀ ; —●— total value ♂ ; —⊞- hot value ♀♂; —□— hot value ♀ ; ⋯⊟⋯ hot value ♀♂, after spontaneous decrease (Stable value); ⋯□⋯ hot value ♀, after spontaneous decrease.

110 mg/dl at the ripening period, and arrives at the summit — more than 200 mg/dl — just before pupation. After pupation, the value decreases, though not so much as it did after the larval ecdysis, falling from 200 mg/dl to 150 mg/dl. During the pupal stage the reducing power pursues a rather level course, though in this case the value sometimes proceeds rising and sometimes falling from pupation until emergence, and it falls down after emergence. These results are, on the whole, similar to those reported by Demjanowski and Prokoffjeva. However, in their case the power in each larval stage goes on decreasing from the beginning to the middle of the stage and then it begins to increase in approaching the sleeping period, while in the present data, this tendency is not shown so clearly and the value seems to decrease more rapidly after ecdysis. This state of the change of the reducing power is nearly the same for different races of the silkworm, though, of course, the absolute values obtained from different races show some slight difference in each case, and even with the same race the values from different breeds do not always coincide with each other. What has drawn my attention in this connection is that the

reducing power of the polyvoltine worms appears to be higher than that of others.

COLD AND HOT VALUES: In the next place, we shall consider the cold value of the Hagedorn Jensen method. The cold value means the reducing value obtained by the cold method after Hagedorn and Jensen. In Gulland and Peters' paper, it runs thus: "Since the Hagedorn and Jensen method involves the liberation of free iodine, it is clear that compounds such as ergothioneine and glutathione, which contain sulphydryl groups, will have an "apparent" reducing value even if stable to ferricyanide, since the amount of ferricyanide reduced is measured by estimating by means of the thiosulphate and the amount of iodine liberated by the excess of ferricyanide. The utilisation of iodine in such oxidations would therefore appear as oxidation by ferricyanide. In the hope of estimating the non-glucose reducing substances by such means, a "cold Hagedorn and Jensen method" has been employed. The sole modification is that the alkaline ferricyanide solution and blood filtrate are not heated but are at once mixed with potassium iodide-zinc sulphate solution, then with acetic acid and titrated with thiosulphate. The blank estimation is of course a simple titration of unheated ferricyanide with thiosulphate." For the present research, the same procedure was employed.

The course of the change of the cold value with the development of the
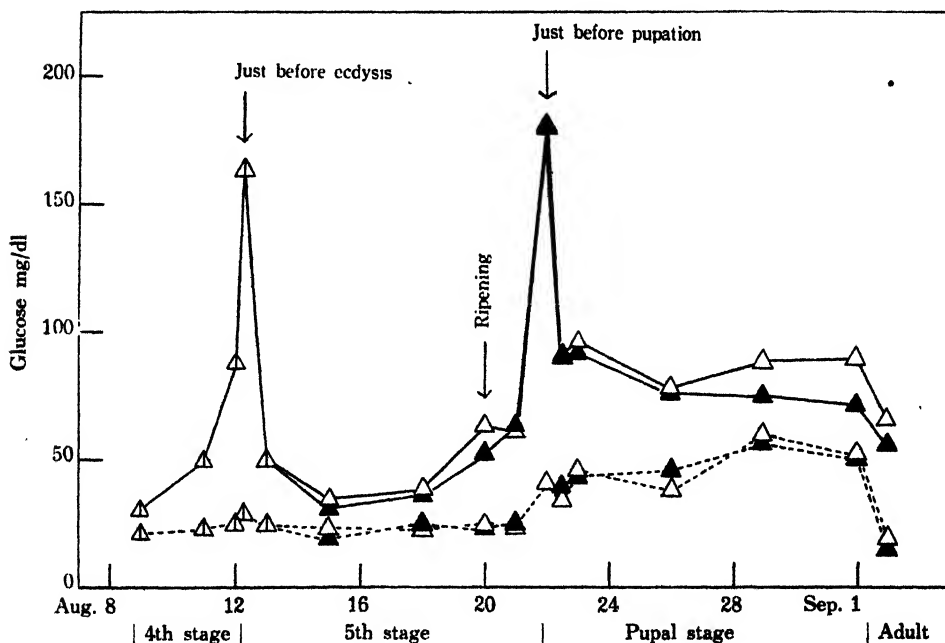
Fig. 2. Course of the reducing power as measured with the zinc hydroxide filtrate. -△- cold value ♀♂; -△- cold value ♀; -▲- cold value ♂; ··△·· cold value after spontaneous decrease ♀♂ (stable value); -△- cold value after spontaneous decrease ♀; ··▲·· cold value after spontaneous decrease ♂.

worm (Table 1, Fig. 2) shows the one similar to that of the total value, though the cold value is lower than the total by about 50 mg/dl. The differences between the total values (the value obtained by the hot method) and the cold values are designated as the hot value, about which explanations will be given later.

Now, it is desirable to consider more carefully the nature of the cold value. Theoretically speaking, in the system of the Hagedorn Jensen method, there may possibly be three courses, as represented in the following scheme, through one of which a reducing substance is oxidized and finally its reducing value is determined by sodium thiosulphate. The first course is supposed to be carried out by such substances which are oxidisable by potassium ferricyanide at a higher temperature such as 100°C, but which are not oxidisable at the ordinary temperature. Then reducing substances oxidisable

1) Reducing substance $\xrightarrow{\text{hot}}$ K$_3$Fe(CN)$_6$ → Iodine → Sodium thiosulphate

2) $\quad$ —— $\xrightarrow{\text{cold}}$ —— → — → ——·

3) $\quad$ —— ———————————→ -- → ——
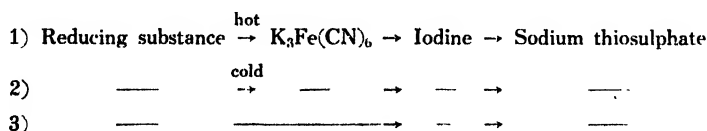
by potassium ferricyanide at the ordinary temperature pass through the second course, and such substances as are stable to potassium ferricyanide but react directly on iodine run along the third one. Indeed, by means of the cold method, the sum of the reducing powers of the latter two groups is determined, and it can not be hoped to discern these two from each other as long as the cold method alone is employed. For the purpose of this discrimination, there is no other way than to introduce iodine directly into the deproteinized filtrate, estimating the amount of reduced iodine from the titration value of residual iodine with sodium thiosulphate. About 0.005 N iodine solution in water accurately checked by sodium thiosulphate was employed. The result shows that the iodine value is very low, being about 5 mg/dl. which is evidently too low to cover the cold value by itself. The fact that the qualitative test of the sulphydryl compounds by the nitroprusside reaction and that of the ergothionein by the Hunter's reaction (Hunter, 1928) of the zinc hydroxide filtrate were negative may be taken as another illustration of the low iodine value. Therefore, it can be concluded that a majority of the cold value results from the cold potassium ferricyanide, and the quantity of such a substance as reacting on iodine directly must be very low.

SPONTANEOUS DECREASE OF THE REDUCING POWER: Let us proceed to mention the spontaneous decrease of the reducing power of the body fluid. As was briefly stated, when the body fluid is taken out of a silkworm body and exposed to the air, the reducing power decreases fairly rapidly down to a certain constant value. This important phenomenon was noticed first in the mixture of the body fluid and the zinc hydroxide solution. When the body fluid is mixed with the zinc hydroxide solution for deproteinization and kept at the ordinary temperature for about an hour instead of boiling immediately as in

the usual procedure, it is found that the reducing power is far lower than the value determined by the standard procedure. On the contrary, once the mixture is treated with boiling water, the reducing power becomes quite stable and it does not exhibit any decrease at all even after 24 hours (Table 2). Further

Table 2

Decrease of the reducing power of the body fluid in the zinc hydroxide solution. Amounts in terms of glucose mg/dl.

		Total value	Cold value
Boiled immediately	Measured immediately	177	108
	Measured after 24 hours	179	108
Boiled after 24 hours		88	27

Table 3

Decrease of the reducing power in various media.
Material: Syô-kô yellow, third day of the fifth stage.
Only the cold values are represented
in terms of glucose mg/dl.

	Boiled immediately	54
Allowed to stand at 25°C, for 24 hours being added a drop of toluol	0.1 body fluid mixed with zinc hydroxide solution	27
	mixed with 1 ml of 0.1 N sodium hydroxide*	53
	mixed with 5 ml of 0.45% zinc sulphate solution**	25
	mixed with 1 ml of water	14
	mixed with 1 ml of a buffer of pH 2.2***	48
	mixed with 1 ml of a buffer of pH 4.0***	29
	mixed with 1 ml of a buffer of pH 6.0***	30
	mixed with 1 ml of a buffer of pH 8.0***	27
	Original body fluid	15

* Deproteinized adding zinc sulphate.
** Deproteinized adding sodium hydroxide.
*** After neutralization deproteinized adding 1 ml of sodium
hydroxide and 5 ml of zinc sulphate. Buffer solutions
were prepared according to McIlvaine acid-phosphate
mixtures.

experiments show that this fact can be observed not only with the mixture of the body fluid and the zinc hydroxide solution, but also either with the original body fluid itself, or with the mixture with water. As will be seen in Table

3, the reducing powers decrease, on the whole, down to nearly the same order within each different medium. It must be noticed, however, that these values for different media can not be regarded as exactly at the same order; in other words, the spontaneous decrease of the reducing power does not always proceed to the same degree within the different media. In the present study attention was concentrated upon the spontaneous decrease within the zinc hydroxide solution leaving minute observations of this interesting fact for future research. Closely related with this phenomenon, there is a noticeable fact that glucose is quite stable in the body fluid which was taken out from the silkworm body. When the body fluid with glucose was allowed to stand for 24 hours either covered with paraffin or exposed to the air, a later measurement showed that
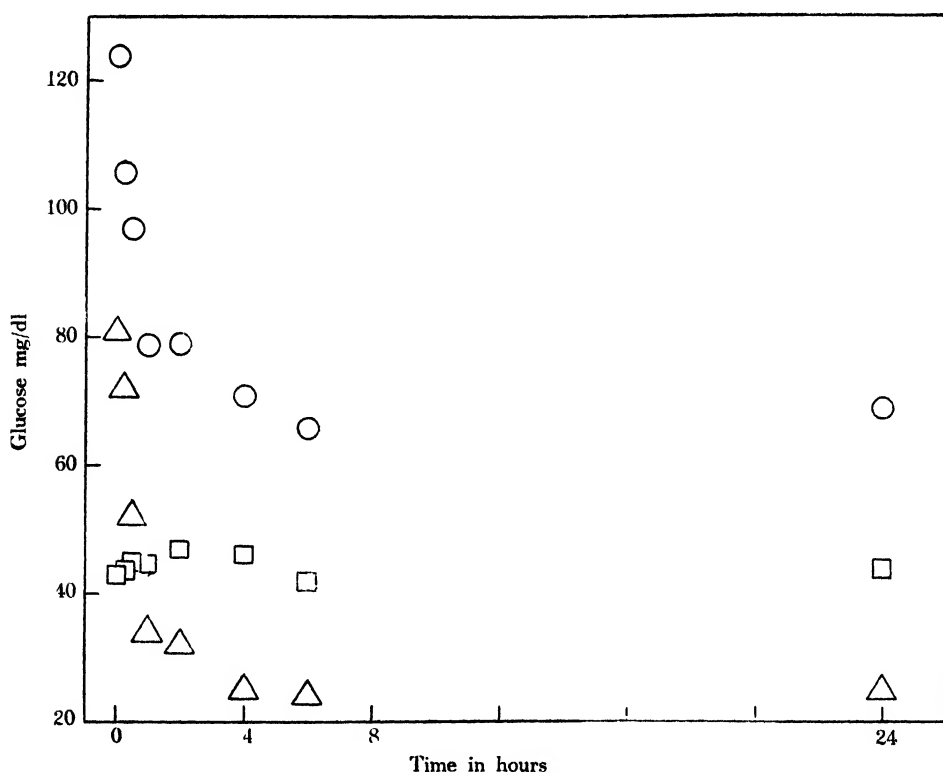
Fig. 3. Time course of the decrease of the reducing power of the body fluid in the zinc hydroxide solution. The reducing powers, represented in terms of glucose mg/dl, are plotted against time in hours.
· Temperature: 25°C. Material: Ringetu, fifth stage.. ○ total value; △ cold value; □ hot value (○~△).

the added glucose had remained unchanged. From this fact it is supposed that no glycolysis occurs in the body fluid, and also that the substance which undergoes spontaneous decrease is not glucose itself.

Experiments were carried out in order to find the time course of the

spontaneous decrease of the reducing power. Material was obtained from larvae of the fifth stage. Many sets of mixture of the body fluid and the zinc hydroxide solution were prepared within the refrigerator of a temperature of 0°C as quickly as possible and then all these sets were taken out and transferred at once into a thermostat regulated at 25°C, where the reaction proceeded satisfactorily. A number of sets were taken out at the intervals as shown in Fig. 3, boiled at once and both the total and the cold values were determined. The result, which is represented in Fig. 3, show that at 25°C the decrease of the reducing power progresses very rapidly for the first one hour, and then more slowly until the end of the fifth or sixth hour, when the action seems to come to a completion.

A following fact will be noticed on examining the hot and the cold values. If the total value is analysed into the cold and the hot values, it is readily found that the cold value decreases fairly rapidly with the lapse of time and the hot value remains on nearly the same level, though it appears to rise a little near the second hour. Therefore, it can be said that a certain substance or substances, which decompose or lose the reducing power on standing are of such a nature as is oxidized by potassium ferricyanide at the ordinary temperature. The result may become more interesting when it is recalled that no glycolysis occurs in the body fluid. In the present paper, the labile value is represented by the difference between the initial value and the residual value after 24 hours.

BALANCE SHEET: In the previous sections we have been dealing with the change of the reducing powers in respect to the total value, the cold value and finally the spontaneous decrease of the reducing power. Now let us analyse the change of the reducing power, making use of the values obtained by means of the methods stated above, and examine the change of each of them with the developmental stages. For the sake of clearness, we might tabulate the following possible cases which can be analysed by combining the various techniques discussed above.

1 Total value, initial ⟍
2 Cold value, initial ⟋ Hot value, initial

3 Total value, after 24 hours ⟍
4 Cold value, after 24 hours ⟋ Hot value, after 24 hours

Subtracting 2) from 1), and 4) from 3), the hot values before and after the spontaneous decrease are obtained; the differences between the values before and after the spontaneous decrease are the labile value. The result of the determinations of these values, from the beginning of the fourth stage till the emergence is summarized in Table 1 and Figs. 1 and 2. In examining the data, attention must be drawn to the fact that only one of these four values*, namely, the cold, labile value shows a remarkable change according to the developmental stages while the other three remain constant as a whole. This fact indicates the following three points. 1) The hot values and the cold, stable values persue a level course. 2) The cold, labile value varies as the

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* Hot stable, hot labile, cold stable and cold labile.

development proceeds, showing a striking increase before ecdysis. 3) Between the hot values before and after the spontaneous decrease, there is practically no difference. This indicates that the hot value contains only the stable fraction. By minute examination of the change of the cold, labile value it will be revealed that the value is very small at the beginning of each stage; it is about 10 mg/dl as is shown in Table 1. Then it increases gradually, rising remarkably during the sleeping period. The highest value is reached just before ecdysis, after which it falls rapidly and repeats the same cycle in the following stages.

Summary

1. The total reducing power shows a striking rise in the sleeping period; the highest value being attained just before ecdysis.

2. The total reducing power contains a fraction of a substance which reduces the Hagedorn Jensen system at the ordinary temperature, which is called a cold value. There are two possibilities in the mode of reaction which can affect the cold value. One is an oxidation-reduction system between the substrate and the iodine which is liberated from potassium ferricyanide and potassium iodide. Since the amount of the iodine utilized in this case has been shown to be small, it is safe to say that the cold value is mostly derived from the reaction between the substrate and the cold ferricyanide.

3. The difference between the total and the cold value is considered as representing the hot value. This value remains nearly constant throughout the stages, while the cold value shows a change similar to that of the total value.

4. The body fluid taken out from the body into the air shows a striking decrease of the reducing power, which is inhibited by heat. This decrease of the reducing power was found to take place in the mixture of the body fluid and the zinc hydroxide solution as well as under other conditions. In the present work the observation was concentrated upon the mixture of zinc hydroxide solution. The decrease at 25°C progresses very rapidly for the first one hour, and after five or six hours it ceases completely at a certain constant level. Analysing the value into fractions, the decrease is found to be limited to the cold value. Therefore, it can be said that the hot value involves only a stable part, while the cold involves both the stable and the labile.

5. No glycolysis takes place in the body fluid which is exposed to the air.

6. Pursuing the courses taken by the labile and the stable, cold values, it is observed that the latter proceeds nearly on a level course, while the former undergoes a change showing a remarkable increase before ecdysis.

7. The reducing powers analysed thus far with the zinc hydroxide filtrate may be tabulated as follows:
   Hot value, changing between 40-60 mg/dl,
   Cold, stable value, 20-50 mg/dl,
   Cold, labile value, 10-130 mg/dl.

8. The striking increase of the reducing power is therefore attributable to the cold, labile value.

REDUCING POWER AS MEASURED WITH THE TUNGSTIC ACID FILTRATE

In this chapter, a variety of reducing powers will be dealt with, all of which were measured with the tungstic acid filtrate. The total reducing power, the hot and the cold values will be mentioned first, and next the application of fermentation for the measurement of the fermentable reducing power and finally statement will be given about the result of hydrolysis as well as the result of the application of fermentation for the hydrolysate. All the measurements were carried out with samples taken from the same source as in the case with the zinc hydroxide filtrate. The precipitation of protein was carried out according to the Folin-Wu's procedure (1919): Eight volumes of $\frac{N}{12}$ sulphuric acid were mixed with one volume of the body fluid; and one volume of 10% sodium tungstate solution was then added. They were mixed well and centrifuged. 1 ml of the filtrate (corresponding to 0.1 ml of the body fluid) gave a satisfactory result. The reducing power was measured by the Hagedorn Jensen method. The fact that the tungstic acid filtrate is employable for the Hagedorn Jensen method was already proved (Hiller and others, 1925).

TOTAL REDUCING POWER: Change of the reducing power as measured by this procedure may be summarized in the following (Table 4 and Fig. 4):

Table 4

Reducing powers as measured with the tungstic acid filtrate.
Amounts in terms of glucose mg/dl. Material: Syô-kô yellow.

Date	Stage	Total value ♀	Total value ♂	Cold value ♀	Cold value ♂	Hot value ♀	Hot value ♂	Residual value after fermentation ♀	Residual value after fermentation ♂	Fermentable value ♀	Fermentable value ♂
August 9	Fourth stage, first day	164		92		72		143		21	
11		138		88		50		132		6	
12	Fourth sleep	146		92		54		148		-2	
12	Just before ecdysis	213		158		55		211		2	
13	Fifth stage	152		88		64		136		16	
15		141	141	79	77	62	64	122	127	19	14
18		110	98	63	54	47	44	102	92	8	6
20	Ripening	120	102	88	65	32	37	122	102	-2	0
21		141	127	105	93	36	34	142	125	1	2
22	Just before pupation	249	240	188	186	61	54	250	240	-1	0
22	Just after pupation	168	155	102	97	66	58	171	155	-3	0
23	Pupal stage	156	152	95	92	61	60	155	154	1	-2
26		145	148	86	88	59	60	145	149	0	-1
29		204	182	122	117	82	65	200	181	4	1
September 1		173	188	106	124	67	64	175	190	-2	-2
2	Adult	154	154	95	97	59	57	154	154	0	0

From the early period to the middle of a stage, the reducing power decreases slowly. And approaching the sleeping period, it increases a little. During the sleeping period, however, it rises strikingly, reaching the maximum just before ecdysis. After ecdysis, the reducing power falls promptly down to almost the same level as it was after the previous ecdysis, and it follows nearly the same course as at the previous stage. This feature is, on the whole, similar to the course of the reducing power as measured with the zinc hydroxide filtrate; in other words, the reducing power suddenly increases during the sleeping period and
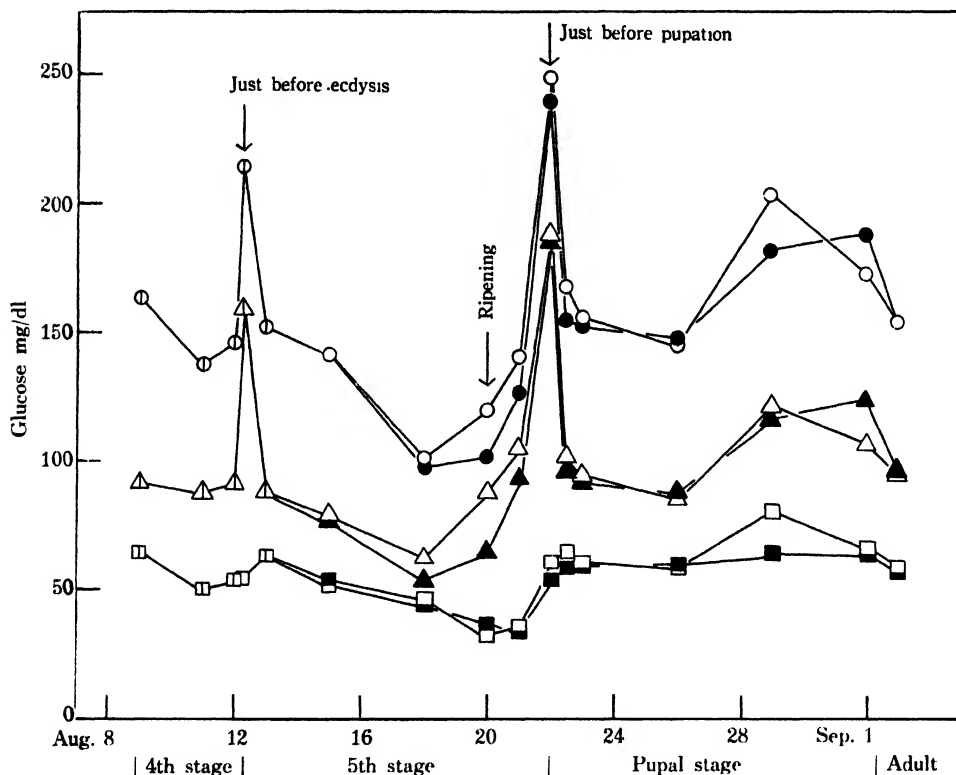
Fig. 4. Course of the reducing powers as measured with the tungstic acid filtrate. Symbols are for the same as those in Figs. 1 and 2.

follows the lower level at the feeding period. However, when we examine carefully these two series of measurements, some differences will be found between them (Table 5). Firstly, at the feeding periods, the reducing power measured with the tungstic acid filtrate is far higher than that obtained with the zinc hydroxide filtrate, while, toward the sleeping period, the difference becomes smaller and just before ecdysis it is extremely slight. For instance, the body fluid of the three day larvae of the fourth stage, as is shown in Tables 1 and 4, possesses the reducing power corresponding to about 140 mg/dl with the tungstic acid filtrate, while about 90 mg/dl with the zinc hydroxide filtrate,

but just before ecdysis, the former becomes 213 mg/dl and the latter 208 mg/dl. Secondly, the reducing power measured with the tungstic acid filtrate keeps decreasing for two or three days after ecdysis and it is late that it begins to rise, while that of the zinc hydroxide filtrate attains the minimum more rapidly ;

Table 5

Comparison between the values with the zinc hydroxide filtrate and those with the tungstic acid filtrate. Amounts in terms of glucose mg/dl. The data of females only are represented.

Date	Stage	Total value			Cold value			Hot value		
		Zinc hydroxide filtrate	Tungstic acid filtrate	Difference	Zinc hydroxide filtrate	Tungstic acid filtrate	Difference	Zinc hydroxide filtrate	Tungstic acid filtrate	Difference
August 9	Fourth stage, first day	91	164	75	31	92	61	60	72	12
11		104	138	34	50	88	38	54	50	-4
12	Fourth sleep	134	146	12	88	92	4	46	54	8
12	Just before ecdysis	208	213	5	163	158	-5	45	55	10
13	Fifth stage	106	152	46	50	88	38	56	64	9
15		92	141	49	34	79	45	58	62	4
18		88	110	22	39	63	24	49	47	-2
20	Ripening	111	120	9	63	88	25	48	32	4
21		113	141	28	61	105	44	52	36	-16
22	Just before pupation	232	249	17	180	188	8	52	61	9
22	Just after pupation	150	168	18	92	102	10	58	66	8
23	Pupal stage	146	156	10	97	95	-2	49	61	2
26		134	145	11	78	86	8	56	59	3
29		145	204	59	88	122	34	57	82	25
September 1		139	173	34	90	106	16	49	67	18
2	Adult	115	154	39	66	95	29	49	59	10

consequently, it begins to rise at an earlier period. There is another important difference in the nature of the tungstic acid filtrate from that of the zinc hydroxide filtrate. In the tungstic filtrate no spontaneous decrease of the reducing power such as found in the zinc filtrate was observed. The filtrate which was left at the ordinary temperature with a drop of toluol even for one day after deproteinization showed quite the same value as determined immediately after the sampling.

Finally it must be noticed that the Hunter's reaction as well as the nitroprusside reaction was also negative with the tungstic acid filtrate and more-over, that the iodine value was almost the same as in the case of the zinc hydroxide filtrate, being about 5 mg/dl in terms of glucose.

COLD AND HOT VALUES (Table 4 and Fig. 4) : The method of determination

and calculation was just the same as was employed for the zinc hydroxide filtrate. Generally speaking, the result is also similar to that obtained with the zinc hydroxide filtrate; that is to say, the hot value generally proceeds on a constant level, while the cold value shows a rise at the sleeping period. An interesting fact is discovered from the comparison between the values measured with the tungstic acid filtrate and those with the zinc hydroxide filtrate (Table 5). As stated above, the former values are larger in magnitude than the latter, and this difference is especially great at the feeding periods. If we compare the cold and the hot values in the same manner, it will readily be found that the difference between the cold values is generally nearer in the magnitude to the difference between the total values than that between the hot values; take for example, the case of the first day of the fourth stage (Table 5): the difference between the total values determined with the two filtrates is 75 mg/dl, and that between the two cold values is 61 mg/dl, while it is 12 mg/dl between the two hot values. This fact is restricted to the larval stages, and no such tendency is observed at the pupal stage. Therefore, it is concluded that it is the cold value at the larval stages that is responsible for the higher values of the tungstic acid filtrate than those of the zinc hydroxide filtrate, while, regarding the pupal stage, no explanation is available at present.

FERMENTATION EXPERIMENT (Tables 4 and 6): Glucose may naturally be considered first in a research regarding the reducing power of the body fluid. Several attempts were made for the demonstration of glucose as osazone from the body fluid of the silkworm, but their results were always negative inspite of the fact that osazone has been demonstrated from some other insects (Frew, 1929). It was already shown in the previous section that the glycolysis does not take place in the body fluid of the silkworm in contrast to the case of the vertebrate blood. So finally it was decided to use the baker's yeast for the purpose of furthering a research in respect to the problem of glucose.

Table 6

Trials of the fermentation experiment.

Material : J 107 Oily, fifth stage, third day.

Amounts in terms of glucose mg/dl.

The fluids were left for 15 minutes at 25°C before the determination of the reducing power.

	Total value
Glucose solution	97
Yeast suspension	1
Yeast suspension plus glucose solution	1
Tungstic acid filtrate of body fluid	93
Tungstic acid filtrate plus yeast suspension	93
Tungstic acid filtrate plus glucose solution	190
Tungstic acid filtrate plus glucose solution plus yeast suspension	94

Yeast fermentation has been frequently used for the analysis of the fermentable reducing power from the total reducing power, and elaborate applications

were made by van Slyke and his collaborators (Hiller and others, 1925; Wenig and Joachim, 1936). Folin and Svedberg reported that the yeast fermentation can be applied to the tungstic acid filtrate (Folin and Svedberg, 1926). In respect to the use of yeast it is the most important point to secure as low a blank as possible, and Somogyi (1927) and Benedict (1928) adopted a procedure of washing yeast repeatedly with distilled water by means of the centrifugation. Benedict employed about 1% suspension in water of the thrice-washed Fleischmann's yeast, which according to him, gives no appreciable blank. In the present tests also this procedure and concentration have been found satisfactory. The procedure of washing yeast here adopted is nearly the same as described by Benedict (1928, p. 465), which is as follows: about 0.5 gm of the yeast prepared by the Oriental Yeast Co. in Tokyo are mixed with about 50 ml of distilled water, thoroughly stirred with a glass rod and the suspension is centrifuged for about one minute with a spead of rotation, about 1000 rotations per minute, the supernatant fluid being poured off after centrifugation. This procedure is repeated three more times, the duration and the spead of centrifugation was in these cases about five minutes and 3500 per minute respectively. The last supernatant fluid is nearly quite clear. The yeast thus washed is suspended in about 50 ml of distilled water and used for the fermentation experiment. At the ordinary temperature this suspension fermented rapidly a small amount of glucose dissolved either in water or in the tungstic acid filtrate of the body fluid, as is shown in Table 6. No additional heating was necessary to accelerate the action. In order to remove the yeast after fermentation centrifugation was solely adopted, and it made the filtrate satisfactorily clear.

The fermentable reducing power was determined only with the tungstic acid filtrate. The use of the original body fluid is impossible for an experiment of this kind, since the fluid is too labile in the air. 5 ml of the yeast suspension prepared as stated above was stirred with 1 ml of the tungstic acid filtrate of the body fluid, sampled from the same source as was used for the total reducing power and this mixture was left for 15 minutes at 25 °C. After the removal of the yeast by centrifugation, the reducing power was measured by the Hagedorn and Jensen procedure. Examining the result of the experiment, represented in Table 4, it is found that the differences between the reducing powers before and after the fermentation is generally very little. This result undubitably shows that there exists no remarkable quantity of glucose in the body fluid of the silkworm, as far as such a type of glucose as added experimentally to the filtrate or the body fluid is concerned.

HYDROLYSIS EXPERIMENT (Table 7): Hydrolysis experiments revealed interesting facts. As is well known, the reducing value produced by hydrolysis depends much upon the technique by which the hydrolysis is undertaken and especially the time and the temperature are important factors therein involved.

For the present case for the sake of convenience of comparison a method which has been proposed by Bierry (1918)* for the hydrolysis experiments of

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* Regarding particulars of the technique of hydrolysis, readers are referred to Grevenstuk (1929).

vertebrates blood was adopted as a technique of hydrolysis: hydrolysis by means of 2.5% sulphuric acid at 120°C for 30 minutes. 1 ml of the body fluid was sampled in a test-tube from the same source as used for the determinations stated in the foregoing pages, mixed vigorously with 1.5 ml of the sulphuric acid and then corked tightly and immersed in a bath filled with glycerin, and regulated at 120°C±0.5. The vessel was left there exactly for 30 minutes. The body fluid thus treated was neutralysed with sodium hydroxide, then deproteinized with tungstic acid, and the final filtrate was made up to 10 ml in quantity. The total and the fermentable reducing powers were determined with 1 ml (corresponding to 0.1 ml of the original body fluid) of the filtrate respectively.

Table 7

Results of the hydrolysis experiments and the determination of glycogen. Amounts in terms of glucose mg/dl.

Date	Stage	Total value		Residual value after fermentation		Fermentable value		Glycogen	
		♀	♂	♀	♂	♀	♂	♀	♂
August 9	Fourth stage, first day	272		159		113		53	
11		282		141		141			
12	Fourth sleep	390		173		217		52	
12	Just before ecdysis	518		238		280		56	
13	Fifth stage	264		155		109		54	
15		208	190	141	122	67	68		
18		339	327	124	115	215	212	57	48
20	Ripening	368	346	177	150	191	196	52	34
21		322	318	186	182	136	136		
22	Just before pupation	442	439	290	290	152	149	131	120
22	Just after pupation	382	368	241	232	141	136		
23	Pupal stage	366	336	200	195	166	141	134	125
26		346	328	221	219	125	109	105	63
29		412	390	255	255	157	135	95	70
September 1		480	628	259	296	221	332	74	70
2	Adult	278	280	177	170	101	110	52	52

Glancing at the total values (Table 7), it will be noticed 1) that on hydrolysis the values become far higher than those before hydrolysis, and 2) that the value after hydrolysis appears to change with the stages, following nearly, if not exactly, the same tendency as that of the value before hydrolysis. As far as our experiments are concerned, the total reducing power after hydrolysis varies between about 200 and 500 mg/dl in terms of glucose, about twice the value before hydrolysis. At an early period of the fourth stage, the value lies at a rather low level and then increases gradually corresponding to

the growth of the worm, and it reaches the maximum at the period just before ecdysis. After ecdysis, the value decreases nearly by 50% and reaches the minimum within two or three days. Thereafter it resumes to increase until ripening, when the maximum is reached. Then the value after showing a little decrease once more during the cocooning period again increases reaching the top just before pupation. After the pupation the reducing power decreases and then follows a course similar to that of previous stages, rising gradually until before emergence, after which the value decreases.

In the next place, let us examine the result obtained by the combination of the fermentation and hydrolysis. 1 ml was sampled from the hydrolysate and fermented by the same procedure as employed for the filtrate before hydrolysis. The result which is summarized in Table 7 shows a striking fact that nearly a half or at least one third of the total value is attributable to the fermentable fraction. The fermentable values varying between about 100 and 300 mg/dl shows an increase at the sleeping period, the ripening period and finally before emergence. Attention should be paid also to the residual value after fermentation: if we compare the residual values in Table 7 with those in Table 4, it will readily be found that, until the middle or later period of the fifth stage, the both values vary parallel to each other, though the residual value after hydrolysis remains a little higher. However, approaching the ripening period the difference between them becomes greater and this discrepancy continues until the adult period. This fact shows at least apparently that hydrolysis gives little effect upon the non-fermentable portion during the period before ripening, while thereafter, there is produced by hydrolysis a certain substance or substances in addition to the fermentable substance, which is measured as the non-fermentable reducing power. The author is fully aware of the possiblity that the fact that there is but little difference between the values before and after hydrolysis may not necessarily mean that hodrolysis causes little change. But, at present, the consideration can not be carried so far.

Regarding the substrate from which a fermentable reducing substance is set free by hydrolysis, many researches have been carried out with the blood of vertebrates (see Grevenstuk, 1929). It is the view generally held that the fermentable value is attributable to some kind of sugar, probably glucose, in combination with protein which is set free by a treatment with heat and acid. One of the evidences to support this idea is that the deproteinized filtrate does not produce the fermentable reducing substance on hydrolysis. 1 ml of the tungstic acid filtrate was hydrolysed by 1.5 ml of 2.5% sulphuric acid following the same procedure as taken for the original body fluid. The result was that the reducing power of the filtrate increases by hydrolysis, but no definite relationship could be obtained from present experiments. Sometimes this increase was almost equal to the fermentable value of the hydrolysed body fluid, but sometimes the increase was even less than half the fermentable value of the hydrolysed body fluid. At any rate, in comparison with the case of vertebrates, it is interesting that there are possibilities that the combined reducing power

is attributable to a substance which is not precipitated by tungstic acid. The solution of this problem depends upon future research.

GLYCOGEN (Table 7): Hydrolysis experiments naturally lead us to the examination of glycogen of the body fluid, which, if present, must be responsible for, at least, a part of the fermentable reducing power produced by hydrolysis. Though glycogen was not found in some insect (Frew, 1929), its presence in the body fluid of a silkworm is certain, as the hydrolysate of the precipitate obtained by means of alcohol from the body fluid digested by potassium hydroxide showed some reducing power. The measurements were carried out by means of a modification of the Pflüger's method, proposed by Osterberg (Osterberg, 1929); 0.1 ml of the body fluid was sufficient for one run. The quantity of glycogen represented in terms of glucose lies generally on the level of 50 mg/dl in the larval stages, a little higher in the pupal stage, and at the time of pupation the value is at the maximum. Therefore, it may be safely said, that, at least half the fermentable value of hydrolysate of the body fluid can be attributed to glycogen.

Summary

1.   The total reducing power as measured with the tungstic acid filtrate changes with the stages following a course similar to that as measured with the zinc hydroxide filtrate. The value of the former filtrate is generally higher han that of the latter, but during sleeping period and also during the ripening these two are nearly on the same level.

2.   Examining the hot and the cold values, it is found that the superiority of the tungstic acid filtrate is caused by some substance or substances which are oxidizable by the ferricyanide solution at ordinary temperature.

3.   The fermentable reducing power in the body fluid is very low, as far as the fermentation by baker's yeast is concerned. The quantity at the feeding periods amounts to 5–20 mg/dl, while at other periods it is nearly zero.

4.   Hydrolysis of the body fluid with sulphuric acid revealed the existence of a fraction of the fermentable reducing power, which is liberated only by hydrolysis. It measures about 100–200 mg/dl in terms of glucose.

5.   The content of glycogen of the body fluid corresponds generally to about 50 mg/dl of glucose. But at the pupating period it becomes about 130 mg/dl.

FATE OF GLUCOSE GIVEN PER OS

The very low value of the amount of free glucose in the body fluid naturally led me to make an attempt to find a course within the body fluid, taken by glucose given per os, in expectation to clarify the part played by glucose in the carbohydrate metabolism of the silkworm. Material used was larvae on the third day of the fifth stage. The method of feeding glucose to the worms was after Hiratsuka (1925): Leaves to be given were moistened moderately by means of spraying water, and a quantity of glucose correspond-

Table 8

Results of the glucose ingestion.
Amounts in terms of glucose mg/dl.

Time in hours after the beginning of ingestion	Total value	Cold value	Residual value after fermentation	Hot value	Fermentable value	Hot value other than fermentable value	Total value	Residual value after fermentation	Fermentable value	Fermentable value produced by hydrolysis
			Tungstic acid filtrate of the body fluid before hydrolysis				Tungstic acid filtrate of the body fluid after hydrolysis			
0	143	72	137	71	6	65	382	131	251	245
1.30	484	72	138	412	346	66	745	134	612	266
3.00	594	66	138	528	456	72	1146	133	1013	557
4.30	350	66	119	284	231	53	658	127	531	300
6.00	110	63	92	47	18	29	888	127	761	743
9.30	95	56	92	39	3	36	924	132	792	789
24.00	98	61	93	37	5	32	528	124	404	399
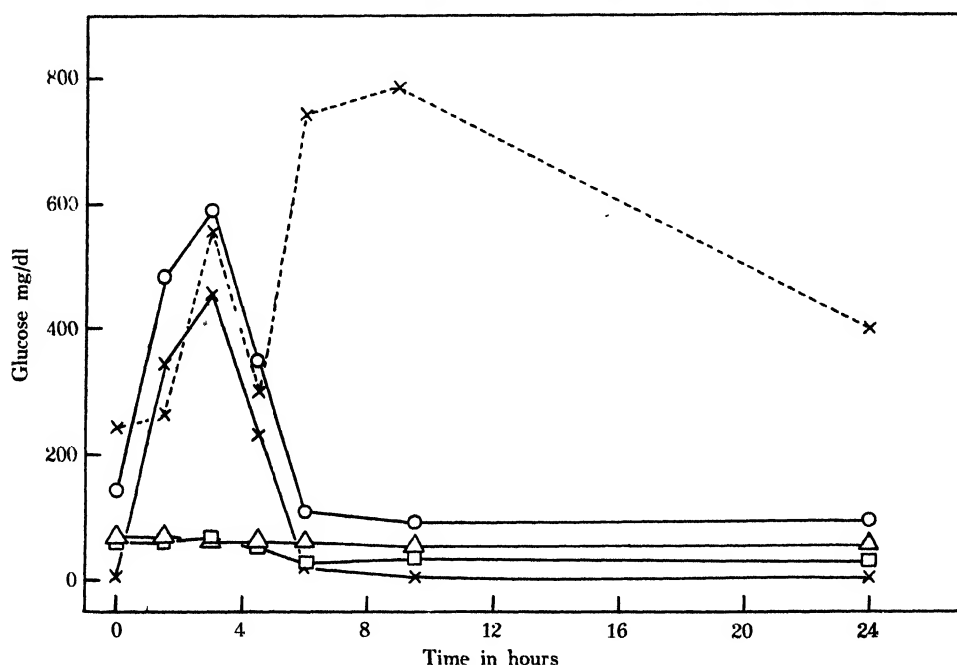
Fig. 5. Results of the glucose ingestion. —✕— fermentable reducing power; ·✕·· fermentable reducing power produced by hydrolysis; other symbols are for the same as in Figs. 1 and 2.

ing to 10% of the leaves in weight was strewed upon the leaves as uniformly as possible, with a sieve of the mesh diameter of 2 mm.   The leaves thus coated with glucose were cut into fragments as usual and were given to the

experimental worms. The worms were allowed to feed on the leaves for one hour, after which they were kept under the fasting condition. Reducing powers were measured with the tungstic acid filtrate at intervals before and after the ingestion, that is, just before the ingestion (about four hours after the previous feeding), one hour and a half, three hours, five hours, six hours, ten hours and finally twenty-four hours respectively after the ingestion. The result is summarized in Table 8 and Figure 5. On examining the total reducing values, it is seen that the effect of glucose ingestion is remarkably manifested at the first measurement and it attains the maximum at the second and the effect still continues for more than six hours after the ingestion. Moreover, it must be noticed that the total values at ten and twenty-four hours are 95 and 98 mg/dl in terms of glucose respectively, both of which are lower than the initial value by about 30%. An analysis of the total value into fractions draws attention to the following points: the cold value may be considered not to change on the whole, while the hot value appears to change taking a course similar to that of the total value, but if separation of hot value into fermentable and non-fermentable parts is made, we shall obtain the non-fermentable hot value, which shows quite a different change from that of the total value. As will be seen in Table 8, the non-fermentable hot value stays level for about three hours, after which it shows a gradual decrease for two or three hours, and from this point on, it remains constant until the end of the experiment. A remarkable change is found in the fermentable value, which rises from 6 to 346 mg/dl during one or two hours and attains the maximum at the third hours after which it decreases so rapidly that three hours after the time of maximum the value is only 18 mg/dl.

Examining the result of the hydrolysis experiment the following facts will be found. The total value after hydrolysis changes following a course similar to that of the total value before hydrolysis, if not exactly so. This curve has two maxima instead of one for the case without hydrolysis, and the value at the end of twenty-four hours is greater than the initial one. The value after fermentation, shown in the next column to that of the total value in Table 8, proceeds ever on a constant level. Since the fermentable value after hydrolysis contains in it the fermentable value before hydrolysis, we must subtract the latter from the former in order to obtain the fermentable value, which is caused to appear as a result of hydrolysis. This is shown in the last column of Table 8. Examination of the values represented here makes it clear that the curve of the total values after hydrolysis with two maximum values, owes its characteristic to the fermentable values produced by hydrolysis. Regarding the residual value after fermentation, if a comparison is made between before and after hydrolysis, it is found that the hydrolysis has no effect for about three hours, after which it brings about a little increase.

The conclusion of the present experiments may run thus: When glucose is fed to a larva, it begins to diffuse at once into the body fluid, but the diffusion seems to progress rather gradually, because it takes about three hours before the maximal fermentable value is reached and it returns to the normal

level by the end of the six hour period. Inanition gives practically no influence upon the cold value, but it makes the hot value decrease by about 50% during a day. The increase of the fermentable value after hydrolysis following the glucose feeding is the most interesting point of the experiment. It may be indubitable that the given glucose is responsible for this fermentable value, — the given glucose is combined with some substance to form a combined sugar and this compound is hydrolysed to set free the glucose again. Concerning the nature of the substance with which the glucose is in combination, no investigation has been tried, — the glucose may be condensed to polysaccharide such as glycogen, or combined with protein or others. At any rate, such a great amount of the production of the combined glucose and also its existence in a great amount in the normal body fluid indicate that the combined glucose must play an important part in the sugar metabolism of the silkworm.

URIC ACID CONTENT

Among reducing substances of the body fluid uric acid is almost the only

Table 9

Content of uric acid.
Amounts in mg/dl.
Material : Syô-kô yellow.

Date	Stage	Apparent uric acid*		Uric acid**	
		♀	♂	♀	♂
August 9	Fourth stage, first day	6.5		3.2	
10		23.0		9.2	
11		17.5		8.7	
12	Fourth sleep	6.6		4.1	
12	Just before ecdysis	6.1		3.2	
13	Fifth stage	10.4		3.8	
14		20.0	20.1	6.1	5.9
15		29.3	23.0	11.1	9.9
16		11.5	10.4	4.4	3.1
18		7.6	6.6	.3.2	3.1
20	Ripening	5.9	5.2	5.0	4.5
21		4.1	5.6	2.7	3.3
22	Just before pupation	6.4	6.9	3.8	4.0
23	Pupal stage	6.4	6.9	4.1	4.6
26		5.4	6.1	3.7	4.5
29		8.2	8.0	8.0	7.5.
September 1		14.5	16.6	11.5	13.9
2	Adult	8.3	13.2	6.6	8.3

* The tungstic acid filtrate of the body fluid was directly employed for the colorimetry.
** Uric acid was isolated by silver lactate.

constituent, the nature of which is known at present. It is nearly certain that the body fluid of a silkworm contains uric acid or urates. This is due to the fact that the fraction of tungstic acid filtrate, precipitated by silver lactate, reduces the phosphotungstic acid showing the blue colour. The measurement of uric acid was carried out according to the Folin's procedure, combining his so-called direct method (Folin, 1930) with the isolation method (Folin, 1922). 5 ml of the tungstic acid filtrate, prepared as stated above, (corresponding to 0.5 ml of the original body fluid) was sufficient for one determination. 7 ml of the silver lactate solution was mixed with 5 ml of the filtrate for the isolation of uric acid, the precipitate being separated by centrifugation. The precipitate was mixed well by means of a glass rod with 1 ml of NaCl in HCl
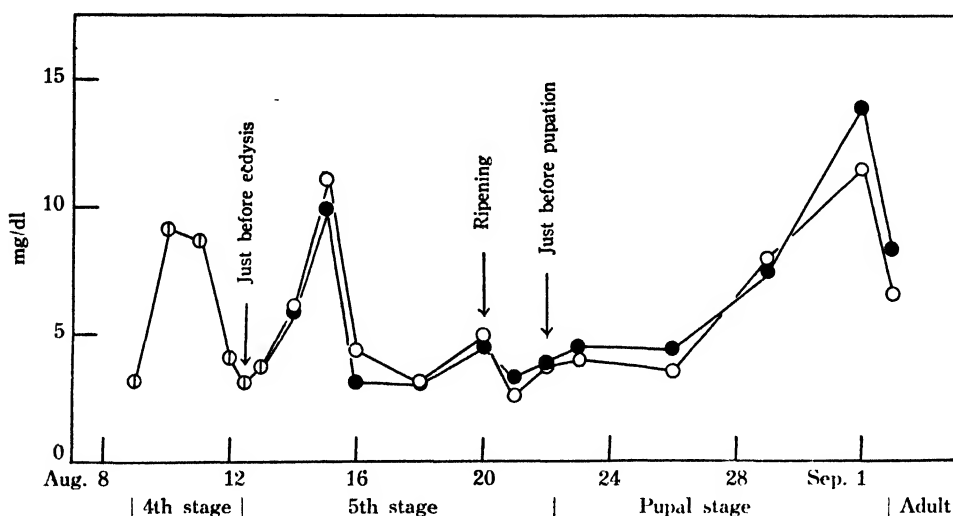
Fig. 6. Quantity of uric acid. ⊕ ♀♂; ( ) ♀; ● ♂.

and 4 ml of water and centrifuged. To the supernatant fluid were added 5 ml of the cyanide-urea solution and 1 ml of the uric acid reagent. The standard was the 0.002% solution of uric acid, which was diluted fresh every day from 0.1% solution. From 0.5 ml to 5 ml of the diluted standard was used according to the content of uric acid in the body fluid.

The result of measurements is as given in Table 9 and Figure 6. The value is high at an earlier days of a feeding period, near the ripening period and also at the later period of the pupal stage. From the latter part of a feeding period to the sleeping period as well as at the later cocooning period, the value is at a very low level, almost next to nothing.

It has already been observed that the reducing power of uric acid as measured by the Hagedorn and Jensen method is 53% of that of glucose (Holden, 1926), and also that uric acid reduces cold potassium ferricyanide solution (Flatow, 1926) showing a value of 53% of that of glucose when oxidized by hot ferricyanide, so that this value remains unchanged when treated

either by hot or cold ferricyanide (Gulland and Peters, 1930). When the values of uric acid are converted into the term of glucose, the content of uric acid will be 7 mg/dl in terms of glucose at most, and generally less than 5 mg/dl. Therefore, it may be said that the reducing power shown by uric acid represents a very small part of the total reducing power which is more than 100 mg/dl. Especially it is in no connection with the striking rise of the reducing power during the sleep, since the uric acid content reaches the lowest, almost nothing, at this period.

NITROGEN CONTENT

It was already mentioned that the body fluid undergoes melanosis when exposed to the air, and also that the reducing power decreases at the same time. On the other hand, it has been supposed by some investigator* dealing with the melanosis that the substrate of melanosis is probably some kind of phenol, which undergoes a change to melanin by an enzymatic action in the

Table 10

Content of nitrogens.
Amounts in mg/dl.
Material: Syô-kô yellow

Date	Stage	Kjeldahl nitrogen				Amino nitrogen	
		Total nitrogen		Residual nitrogen (tungstic acid filtrate)			
		♀	♂	♀	♂	♀	♂
September 5	Fourth stage, first day	399		308		229	
7		550		301		300	
8	Fourth sleep	553		263		218	
9	Just before ecdysis	481		252		216	
9	Fifth stage	413	413	240	224	199	200
11		494	421	203	196	188	180
13		800	590	273	252	216	227
14	Ripening	1344	1266	217	182	197	157
15		1035	924	168	140	149	135
16		889	826	224	175	203	174
17	Just before pupation	1288	1134	273	245	258	222
18	Pupal stage	819	714	226	200	223	189
21		847	784	278	247	245	245
24		889	868	315	308	262	246
27		546	483	280	238	267	194
28	Adult	574	917	259	224	199	169

* Private letter from Dr. Tsunao Watanabe of our Experiment Station.

presence of oxygen. When the decrease of the reducing power in the exposed body fluid was noticed, it was supposed at once that the decrease may be in a close connection with the melanosis, that is to say, the labile fraction of the reducing power may be attributed to some phenol. Moreover, there is another basis for this supposition. That is the fact that the degree of melanosis is most intense at the sleeping period especially just before ecdysis, when the labile fraction is at the maximum value. If this supposition be correct, the increase of the reducing power would be accompanied by a rise in the nitrogen content.

The total nitrogen was determined with 0.1 or 0.2 ml of the body fluid by means of the micro-Kjeldahl method. In this case a general principle of the Folin-Farmer procedure (Folin-Farmer, 1912) was followed, but instead of
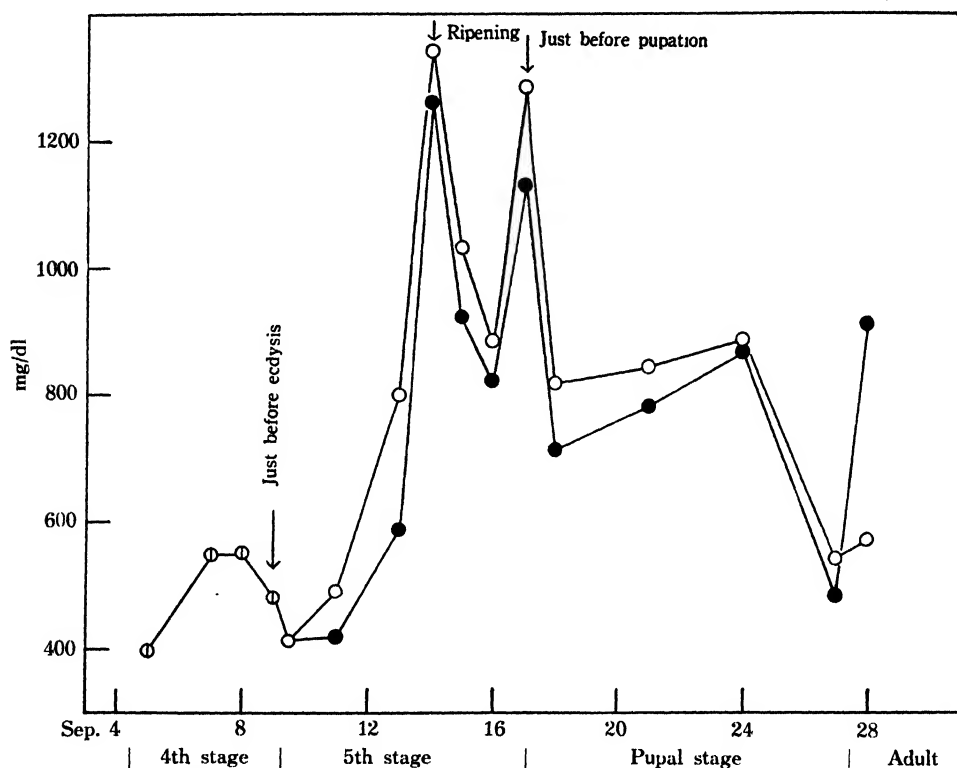
Fig. 7. Quantity of the total Kjeldahl nitrogen. ① ♀³; ○ ♀; ● ♂.

the Nesslerization the titration with 0.1 N sodium hydroxide was employed. The result will be seen in Table 10 and Figure 7. The content of the total Kjeldahl nitrogen varies between about 400 and 1300 mg/dl, showing especially a high value from ripening to pupation. The course of change may be summarized as follows: The value increases at the feeding period and decreases during the sleep. Approaching ripening, the rate of increase becomes much

more striking, but during the cocooning the value decreases. At the pupating period it becomes once higher and then falls suddenly. For a week following this, it increases slightly, but thereafter it decreases until before emergence. The moth, newly emerged, shows a higher value and it is especially so in males. It is worthy of notice that the course of change of the total nitrogen is nearly parallel to that of the dry matter. This will probably show that the main component which is in an intimate relation with the quantity of dry matter is protein.

The quantity of the residual nitrogen which was determined with the tungstic acid filtrate by means of the Kjeldahl method shows a less remarkable change than that of the total nitrogen throughout the stages, varying between about 150 and 300 mg/dl, but the phases of the change are nearly similar to that of the total nitrogen. The maximal point was met before the sleep, at the ripening and also at the pupation. The content of the free amino-nitrogen which was determined by means of the van Slyke method (van Slyke, 1911) shows nearly the same course as that of the residual nitrogen.

Thus far, it is not possible to give a definite answer to a question whether or not the decrease of the reducing power can be attributed to the decomposition of some nitrogenous substance, which can externally be observed as melanosis. In my opinion, however, it is too soon to give up this problem, because it is possible that a change of nitrogen, which is accompanied by a change in the reducing power, may be very small.

WATER CONTENT

A question arises as a next step, whether or not the rise of the reducing power before ecdysis is owing to a real increase of the quantity of reducing substances, because a rise of the reducing power may possibly be caused by an increase of the amount of dry matter in the body fluid, or by a decrease of the water content of the body fluid, namely, a concentration. In order to make this point completely clear it is necessary to determine accurately the amount of the body fluid as well as the absolute quantity of water in the body fluid of an individual. But this was abandoned because of technical difficulties. A determination of the water content of an unit volume of the body fluid was carried out. A sample was evaporated within a bath kept at 105 °C. The difference between wet and dry weight is regarded as the water content.

The result is summed up on Table 11. The water content of the body fluid is about 980 mg/ml at the fourth stage. Entering the sleeping period, the content begins to increase and the increase continues even after ecdysis until a larva begins to feed again, the maximum being at nearly the same level as that of the beginning of the previous stage. At the fifth stage, the quantity continues to decrease until after ripening, when the value attains about 915 mg/ml in female and 935 mg/ml in male. Then, the value once rises a little, and afterwards falls again just before pupation. At the pupal stage we

observe a rise after pupation, and since then the curve goes down until before emergence when it rises again. The water content of the body fluid of moths is lower than that of pupae just before emergence and especially it is worth noticing that the value is remarkably lower in the male, while until then the male keeps generally a higher value.

<div align="center">

Table 11

Weight of the fresh and the dried body fluid and the
water content.
Amounts in gm/ml.

</div>

Date		Stage	Fresh weight		Dried weight		Water content	
			♀	♂	♀	♂	♀	♂
September	5	Fourth stage, first day	1.0330		0.0544		0.9786	
	7		1.0448		0.0662		0.9786	
	8	Fourth sleep	1.0278		0.0662		0.9616	
	9	Just before ecdysis	1.0300		0.0608		0.9692	
	9	Fifth stage	1.0298		0.0537		0.9761	
	11		1.0312	1.0326	0.0596	0.0586	0.9716	0.9740
	13		1.0324	1.0292	0.0788	0.0664	0.9536	0.9628
	14	Ripening	1.0362	1.0354	0.1148	0.0936	0.9214	0.9418
	15		1.0312	1.0326	0.1152	0.0970	0.9160	0.9356
	16		1.0382	1.0314	0.1070	0.0920	0.9312	0.9394
	17	Just before pupation	1.0266	1.0258	0.1124	0.1004	0.9142	0.9254
	18	Pupal stage	1.0300	1.0266	0.0943	0.0824	0.9357	0.9442
	21		1.0306	1.0304	0.1016	0.0870	0.9290	0.9434
	24		1.0222	1.0190	0.0880	0.0856	0.9342	0.9334
	27		1.0158	1.0152	0.0656	0.0662	0.9502	0.9490
	28	Adult	1.0124	1.0212	0.0726	0.1116	0.9398	0.9096

Looking over the result just mentioned above the first thing to be noticed is that the water content of the body fluid increases during the sleeping period. It may be interpreted as a direct effect of inanition, since the increase continues until the beginning of feeding. Second, attention is directed to a striking decrease during the fifth stage, which continues until after the beginning of cocooning. Third, the water content of males is generally higher than that of females, except at the period from the later pupal stage to adult. Finally we must examine the main problem; e. i., the relation between the water content and the reducing power of the body fluid. The state at the sleeping period needs no explanation; the water content increases as time goes on, so that there is no room to question that the increase of the reducing power is caused by the absolute increase of the amount of reducing substances. Regarding pupation, though the water content attains a minimum just before pupation,

its difference from the value of the previous and the following day is too slight to consider the rise of the reducing power simply as a result of the decrease of the water content of the body fluid.

As a conclusion, it is safe to say that the increase of the reducing power before ecdysis is caused by an actual increase of some reducing substance or substances.

GENERAL CONSIDERATION

Looking over the results, two main groups of problems present themselves. One is the striking increase of the reducing power before ecdysis, and the other is the problem of glucose.

It is certain that the striking increase of the reducing power is not an apparent phenomenon caused by the increase of the concentration of the body fluid, but it is the result of an absolute increase of the amount of reducing substances. The primary proof for this fact is that the quantity of water of the body fluid changes at the periods under consideration within a very limited range, when compared with the change of the reducing power. Furthermore, the observation of the reducing power itself would lead us to the same conclusion. It is only one of the values — the cold, labile value — which shows a remarkable increase, and the others run practically on a level course.

As to the nature of the substance which is responsible for the increase of the reducing power in question, it has been clarified until now that the substance is oxidizable by the cold potassium ferricyanide, and is labile in the air. It is not probable however that the substance is of such nature as can reduce iodine or phosphotungstic acid. Because the iodine value is at a very low level throughout the stages, and the value of apparent uric acid falls much before ecdysis (see Table 9). Therefore, at least from the present results, it can not be considered that such substances as glutathione, glucuronic acid and phenols are responsible for the striking rise of the reducing power in question.

A low value of the fermentable reducing power of the body fluid is one of the most striking facts which have been found in the present work. The author believes that the present method is good enough to lead us to a correct conclusion, taking the fact into account that glucose which is added to the body fluid or to filtrate is clearly fermented, and also that the fermentation takes place in the filtrate of the hydrolysed body fluid. Since the free fermentable reducing power is very low, it is obvious that such sugars as glucose or fructose are contained in a free state in the body fluid of the silkworm but in a very small quantity. An idea may be proposed that glucose may possibly exist as a form stable to fermentation. At the present state of our knowledge, however, this problem can not be discussed with certainty. The low value of the fermentable power in the body fluid of a silkworm may be of interest, when we recall previous researches about the state of glucose in the blood of other animals. It may be needless to say about vertebrates. Regarding Arthropods osazone has been demonstrated from a kind of beetles (Frew, 1929)

and a high value of the fermentable reducing power has been demonstrated in the blood serum of *Limulus* (Fremont-Smith and Dailey, 1932).

Another remarkable fact is a high value of the fermentable reducing power of the hydrolysed body fluid or a combined fermentable value. This may acquire a greater importance when we consider it together with a low value of the free fermentable power. I want to point out that, in the blood of *Limulus*, in which the fermentable reducing power is fairly high, the hydrolysis does not increase the reducing power any farther (Fremont-Smith and Dailey, 1932), and for the silkworm, where the free fermentable value is very low, the reducing power increases very much on hydrolysis.

Table 12

Balance sheet of the reducing powers.
Amounts in terms of glucose mg/dl, except uric acid.
The case of female only is represented.

| Date | Stage | Total value | | Hot value | | | Cold value | | | | |
		Zinc hydroxide filtrate	Tungstic acid filtrate	Zinc hydroxide filtrate	Tungstic acid filtrate	Fermentable value	Zinc hydroxide filtrate Stable	Zinc hydroxide filtrate Labile	Difference between tungsten and zinc filtrates	Uric acid content mg/dl	Fermentable value produced by hydrolysis
August 11	Fourth stage	104	138	54	50	6	23	27	38	8.7	141
12	Just before ecdysis	208	213	45	55	2	29	134	5	3.2	280
15	Fifth stage	92	141	58	62	19	24	10	45	11.1	67
20	Ripening	111	120	48	32	2	25	38	25	5.0	191
22	Just before pupation	232	249	52	61	-1	42	138	8	3.8	152
26	Pupal stage	134	145	56	59	0	38	40	8	3.7	125

Concerning the substrate, which is responsible for the fermentable reducing power, either free or combined, it may not be unjustifiable, if we assume the substrate, e. i., the fermentable substance in the body fluid to be glucose. At any rate, so far as glucose is regarded as an agent to play an important function in the metabolism of the silkworm, importance must naturally be attached to the combined glucose.

In the next place, the sex difference will be examined. In almost all cases, the value in the female is a little higher than that in the male. Regarding a dry matter also the value in the female is higher than that in the male, except at the adult stage, where the reverse is true. The superiority of the female value is probably due to the fact that the water content is lower in the female. The only exception in the present work is found in uric acid; its

value in the male is higher after ripening until adult, though the relation is reverse before the ripening. The superiority of the male in the uric acid content during the pupal stage can also be seen in the data of Akao (Akao, 1931).

Examining through the results, a balance sheet of the reducing power at representative periods may be drawn, as shown in Table 12. At the ecdysis period, the hot value occupies 25% of the total value, the cold stable value 15–20% and the cold labile value 60% ; the fermentable value and the uric acid content are both negligible. At other periods than during the ecdysis, the hot value occupies 40–50% of the total value, the cold stable value 15–25% and the cold labile value 20% generally. The fementable value attains to a considerable amount at the feeding period, about 5–20% of the total, and a similar tendency is taken by uric acid, 5% at the feeding period. A part of the cold power, which is measured only with tungstic acid filtrate, amounts to a considerable value, about 30%, at the feeding period.

SUMMARY

1) Various kinds of the reducing power of the body fluid of the silkworm were measured from the beginning of the fourth larval stage to the adult by means of the Hagedorn Jensen method, with zinc hydroxide filtrate and with tungstic acid filtrate. In addition to these, determinations were undertaken regarding uric acid, nitrogen and also the water content.

2) The total reducing power shows a striking increase at the sleeping and the pupating period just before ecdysis, attaining to a maximum of about 200 mg/dl, though at other periods it runs on a rather level course of about 100 mg/dl in terms of glucose.

3) The body fluid contains a reducing substance or substances which are oxidized by the potassium ferricyanide solution at the ordinary temperature. This is called the cold method, and the standard Hagedorn Jensen method is called the hot method.

4) When the body fluid is exposed to the air, the reducing power decreases spontaneously. This phenomenon occurs also in the mixture of the body fluid and the zinc hydroxide solution, but it is inhibited by heat.

5) Making use of the hot and the cold method and also the spontaneous decrease of the reducing power of the fluid in zinc hydroxide filtrate, it has been shown that the striking increase in question is caused by some reducing substance which is labile in the air and is oxidized by the cold ferricyanide.

6) The values obtained from zinc hydroxide and tungstic acid filtrates are on the same level on the whole. On examining closely, the latter one is found higher at the feeding period, the difference being about 50 mg/dl at most, which is due to a difference in the cold values.

7) The reducing power which is responsible for the consumption of iodine is very low.

8) Making use of tungstic acid filtrate, baker's yeast and hydrolysis, some

aspect was approached in regard to the state of sugar in the body fluid. The free fermentable reducing power of the filtrate is almost nothing, except at the feeding period, even when the value hardly amounts to 20 mg/dl.

9) When hydrolysed by sulphuric acid, there is a great deal of increase of the reducing power, almost all of which is fermentable.

10) When glucose is given per os, the free fermentable value reaches the maximum about three hours after the ingestion and returns to the original level at the end of six hours. It is worth of notice that in this case the combined fermentable reducing power increases.

11) Uric acid content shows a high value, about 10 mg/dl at the middle of the feeding period and before emergence, while very low at other periods, less than 5 mg/dl.

12) The amount of the total Kjeldahl nitrogen is rather low at the fourth stage, especially low at the sleeping period. At the fifth stage it increases exceedingly until ripening; after pupation it decreases promptly and then takes a rather level course for several days and the value decreases much toward the emergence, which is followed by another. The values of the residual and the free amino-nitrogen run approximately on the same course, which is rather level.

13) The water content of the body fluid follows a nearly reverse course of that of the total nitrogen.

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16. Statistics of the Body Weight of the Silkworm

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(With 2 Text-figures and 11 Tables)

A series of observations were undertaken from the statistic point of view to examine the reliability of the observed value of the body weight of the silkworm. The first section of the present paper deals with the precision of the reliability of the average value, and the second the individual difference of the chronic change of the body weight.

I

In the first place let us examine whether or not the frequency distribution of the body weight of the silkworm follows the Quetelet's law ; it cannot be expected without actual observation that the distribution follows this law, though, as is well known, there are so many kinds of biological quantities which follow the said law.

Material was obtained from the fifth day larva of the fifth stage of Syôkô-yellow (750 individuals each for both sexes) and the sixth day pupa of
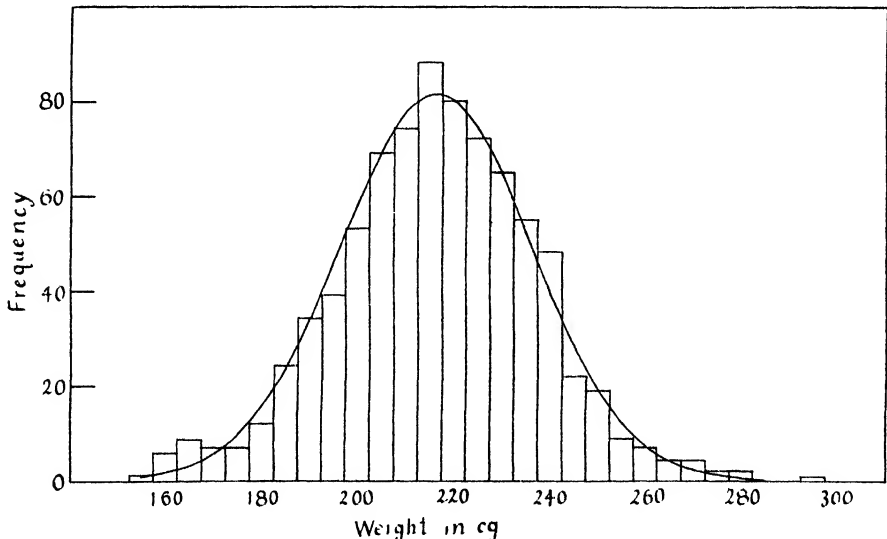
Fig. 1. Frequency distribution of the body weight of female pupa The curve is drawn according to the Gaussian formula.

E 18 (about 1000 individuals each for both sexes). The measurement was carried out using a balance which is properly prepared for weighing cocoon, the scale being read by every 0.05 gm. The values observed were recorded and numbered as shown in Table 10. For the measurement of about 1000 worms it took about one hour. The frequency distributions of the body weights are shown in Table 1 and Fig. 1. The frequency distribution appears to fit well in general the curve of the *a priori* probability according to the Gaussian formula [1]. Fig. 1 may be sufficient to conclude the applicability of the Quetelet's formula to the body weight of the silkworm. Accordingly,

Table 1

Frequency distribritions of the body weights recorded in Table 10.

Female larva			Male larva		
Weight in cg	Frequency observed	Frequency calculated	Weight in cg	Frequency observed	Frequency calculated
150	1	0.1	145	5	4.2
155	3	0.3	150	10	8.8
160	3	0.7	155	15	16.7
165	2	1.5	160	30	29.0
170	4	3.0	165	34	45.0
175	5	5.4	170	68	63.3
180	15	9.2	175	78	80.3
185	13	15.0	180	111	91.1
190	19	22.5	185	91	95.3
195	29	32.3	190	94	89.1
200	50	43.0	195	77	75.3
205	33	54.2	200	49	57.4
210	51	64.0	205	38	39.5
215	69	71.2	210	25	24.6
220	84	74.3	215	8	13.7
225	81	73.1	220	11	7.0
230	62	67.4	225	5	3.1
235	64	58.3	230	0	1.2
240	62	47.6	235	1	0.5
245	38	36.5			
250	24	26.2			
255	9	17.7			
260	16	11.3			
265	4	6.7			
270	6	3.8			
275	3	2.0			

[1] Sheppard, 1904, Biometrika **2**.

Table   1 — continued

Female pupa			Male pupa		
Weight in cg	Frequency observed	Frequency calculated	Weight in cg	Frequency observed	Frequency calculated
155	1	0.7	110	2	0.7
160	6	1.5	115	1	1.9
165	9	2.9	120	8	5.3
170	7	5.5	125	12	12.2
175	7	9.5	130	24	24.9
180	12	15.5	135	41	45.2
185	24	23.6	140	79	73.3
190	34	34.0	145	110	105.9
195	39	45.9	150	147	136.8
200	53	58.2	155	157	157.3
205	69	69.2	160	187	161.3
210	74	77.3	165	123	147.3
215	88	81.0	170	135	120.4
220	80	79.8	175	64	87.3
225	72	73.9	180	47	56.8
230	65	64.1	185	40	32.7
235	55	52.3	190	21	16.9
240	48	40.1	195	8	7.7
245	22	28.6	200	7	3.2
250	19	19.5	205	6	1.1
255	9	12.3	210	2	0.3
260	7	7.2	215	1	0.1
265	4	4.1			
270	4	2.1			
275	2	1.1			
280	2	0.4			
285	0	0.2			
290	0	0.0			
295	1	0.0			

various theorems which are deduced from the Quetelet's law can safely be applied to the body weight.

It is a well known fact[2] that when the standard deviation is given, the standard deviation of the arithmetic means can be computed using the formula $\sigma_m = \dfrac{\bar{\sigma}}{\sqrt{m}}$, where $\bar{\sigma}$ represents the standard deviation, σ_m the standard deviation

[2] See, for example, Risser et Traynard 1933. Traité du calcul des Probabilités et de ces applications, T. 1. Fas. 4. Paris. p. 78.

of the arithmetic mean, and m the number of individuals on which the arithmetic mean is computed. If $\bar{\sigma}$ is nearly equal to the true standard deviation — if the number of individuals on which $\bar{\sigma}$ is computed is sufficiently great[1] — σ_m might be highly reliable. But, in actual cases, when the precision of the arithmetic mean is computed by means of this formula, $\bar{\sigma}$ can not be computed on so many individuals. As a practical affair, therefore, it becomes important to examine how the reliability of an average is reliable, when the standard deviation is not computed on sufficiently great number of individuals.

The standard deviation of the standard deviation can be computed by means of the formula $\sigma_\sigma = \dfrac{\sigma}{\sqrt{2n}}$ [1] where σ_σ represents the standard deviation of the standard deviation, σ the standard deviation, and n the number of individuals on which σ is computed. Employing $\sigma_\sigma = \dfrac{\bar{\sigma}}{\sqrt{2n}}$ and $\sigma_m = \dfrac{\sigma}{\sqrt{m}}$, the reliability of the standard deviation of arithmetic mean (literally speaking σ might be the inverse of the reliability) can be computed. In Table 2 are shown fifty $\bar{\sigma}$'s of the male larval case which are respectively computed on different combina-

Table 2

50 standard deviations computed on 50 individuals with the standard deviation

No.	Standard deviation	No.	Standard deviation	No	Standard deviation
1	16.8	18	15.8	35	10.5
2	15.2	19	16.1	36	13.4
3	15.6	20	13.7	37	17.6
4	18.6	21	16.4	38	14.3
5	12.7	22	12.5	39	15.5
6	14.9	23	16.0	40	14.0
7	14.7	24	15.1	41	16.0
8	15.8	25	15.6	42	15.7
9	13.8	26	16.1	43	16.0
10	15.1	27	18.1	44	16.5
11	13.1	28	17.1	45	14.4
12	15.7	29	15.1	46	13.8
13	10.4	30	14.2	47	16.1
14	15.9	31	16.2	48	15.1
15	14.4	32	15.2	49	15.9
16	13.4	33	15.6	50	13.1
17	12.4	34	13.8		

Arithmetic mean 14.98   Standard deviation ±1.63

[1] Mitomori, 1929. Bull. Imp. Tokyo Sericul Coll., **3**.
[1] Pearl, 1908 Biometrika **6**.

tions of fifty individuals, employing the data of Table 10. σ_σ computed on $\bar{\sigma}$ by means of the formula $\sigma_\sigma = \frac{\bar{\sigma}}{\sqrt{2n}}$ may be between about ± 1.0 and ± 1.8. And σ_σ as actually computed on these fifty $\bar{\sigma}$'s is ± 1.6; the domain in which nearly all $\bar{\sigma}$'s is contained may be about ± 5. Accordingly, the standard deviation of average as computed by means of $\sigma_m = \frac{\bar{\sigma}}{\sqrt{m}}$, where σ is computed on fifty individuals, may be $\frac{15.0 \pm 1.6}{\sqrt{m}}$.

Then the standard deviation of the arithmetic mean as actually computed on the arithmetic means will be mentioned. The process of calculation was as follows. Based upon the records of the body weights (Table 10), a certain number of combinations were made which consist of a certain number of individuals, and the arithmetic means of each combination and the standard deviation of the arithmetic means were computed. Changing the number of individuals for one combination, several series of combinatios were obtained. In the present calculations 50 combinations of 1, 10, 25, 50 and 100 individuals were made. Then from these 50 means the standard deviation was calculated for each case.

There is an important fact which must be remarked here: If the total number of individuals is not sufficiently great in order to take one individual for once only, there might occur such case that the same individual must be taken more than once for making a certain series of combinations, that is to say, for instance, for making 50 series of 10 individuals, 500 individuals is just sufficient in order to take one individual for only once; but in order to make 50 series of more than 25 individuals, more than 1250 individuals are necessary. If the total number is less than 1250, therefore, one individual must be sampled for more than once. Exactly speaking this should be avoided. On the other hand, as a practical matter, it is almost impossible to obtain so many values, especially in the case of larva, when the time for the measurement must be as short as possible. In the present work, one individual was taken for more than once except in the case of 10 individuals. Here it is necessary to examine critically how the results calculated from the number of individuals which is not sufficiently great is reliable. In the first place the result of making 50 combinations of 10 individuals on 500 individuals will be compared with that on 100 individuals. In the former case each individual, of course, is sampled for only once, while in the latter every one must be employed for five times. Calculations of the first 100 and 500 values of the case of female larva in Table 10 show that the standard deviation of the arithmetic means is ± 4.6 in the former case, and ± 4.8 in the latter. The difference between these two values cannot be regarded as remarkable. Second examination is shown in Table 3, which was carried out under the same idea as the first one, but from a slightly different angle. There are shown four series of the frequency distribution of the body weight of the case of male larva: the distributions of the first 100,

Table 3

Frequency distributions of male larva.

Weight in cg	First 100	First 250	First 500	750 (total)	Frequency of 1st 100×7.5	Frequency of 1st 250×3	Frequency of 1st 500×1.5
150		1	1	1		3	1.5
155	1	1	3	3	7.5	3	4.5
160		1	1	3		3	1.5
165			1	2			1.5
170		3	3	4		9	1.5
175	3	3	3	5	22.5	9	4.5
180		3	8	15		9	12.0
185	2	4	11	13	15.0	12	16.5
190	2	5	10	19	15.0	15	15.0
195	4	7	11	29	30.0	21	21.0
200	8	17	29	50	60.0	51	43.5
205	2	7	16	33	15.0	21	24.0
210	5	18	30	51	37.5	54	45.0
215	11	22	44	69	82.5	66	66.0
220	10	29	56	84	75.0	87	84.0
225	11	28	60	81	82.5	84	90.0
230	8	20	43	62	60.0	60	64.5
235	8	17	41	64	60.0	51	61.5
240	10	22	17	62	75.0	66	70.5
245	3	14	28	38	22.5	42	42.0
250	6	12	20	24	45.0	36	30.0
255	1	3	7	9	7.5	9	10.5
260	3	6	13	16	22.5	18	19.5
265		3	3	4		9	4.5
270		2	5	6		6	7.5
275	2	2	3	3	15.0	6	4.5

250 and 500 and the total 750 values of Table 10. On examining them some discrepancy may be seen at the both extremities, but at the middle, the frequencies of the same class are generally at the same level. From this test also, it may be concluded that, within certain limited range, to sample the same individuals for more than once does not give much influence upon the result.

As an example of making the combinations, the case of male pupa will be described (see Table 4). For the case of making 50 combinations of 10 individuals, a set of 10 individuals is made at every 10 from the first. For the cases of 25, 50 and 100 respectively, several ways of combination are employed which can be seen in Table 1. The standard deviation of these 50 arithmetic means is computed for each case employing the formula $\sigma = \sqrt{\dfrac{\Sigma a^2}{50}}$,

Table 4

Showing an example of making 4 series of 50 combinations.
The case of male pupa; total number of individuals 1222.
(Original record in Table 10)

1 Making 50 combinations of 10 individuals

No. of combination | No. of individual taken which corresponds to No in Table 10

1)   1, 2,··············· 9, 10.
2   11, 12,···· ·········19, 20.
      ··· ················ · ·····
50)   491, 492,··· ········· 500.

2 Making 50 combinations of 25 individuals

1)   1, 2,· ····· ······25
2)   26, 27,···· ··· ·····50.
      ····················· ·····
48.   1176, 1177,· ········ ·· 1200.
49   1, 31, 61,····· ·······721
50)   2, 32,············· ·722.

3 Making 50 combinations of 50 individuals

1)   1, 2,·· ··· ···· 50.
2,   51, 52, ·· · ··· ··100.
      ······ ··· · ········ ··
24)   1151, 1152,···· · ··· 1200
25)   1, 31, 61,·· ····1141, 1171, 2, 32,··· ····242, 272.
26)   302, 332, · ···1142, 1172, 3, 33, ·· ··· 543, 573
      · ··· ···· ·······
48,   929, 959, ·· ·1169, 1199, 30, 60,· ······1170, 1200.
49   1, 15 29, ·· · ··   673, 687.
50)   701, 715,········1205, 1219, 2, 16, ·· ····156

4 Making 50 combinations of 100 individuals

1)   1)+2, of the case of 50 individuals
2)   3)+4)   ,,
      · ······· · ·········
24)   47)+48)   ,,
25,   1, 15,·· ·····1205, 1219, 2, 16,·········142, 156
26·   170, 184,······ ·1206, 1220, 3, 17,·······325.
      ······ ···· ·········
36·   727, 741,· ····· 1203, 1217, 14, 28,···· ···882, 895.
37)   1, 32,······1179, 1210, 2, 33,····· ·1180, 1211, 3, 34, · ···592.
38   623, 654,····1181, 1212, 1, 35,· ··1182, 1213, 5, 36, · ·1183, 1214.
      ·· ··· ··· ··· ··
47,   367, 398,····1173, 1204, 27, 58,· · 1174, 1205, 28, 59, ···1020.
48)   1, 30, 59,····1161, 1190, 2, 31, · ·1162, 1191, 3, 32,·····438.
      ······ ···· ·········
50)   933, 962,··1165, 1194, 6, 35,··1166, 1195, 7, 36··1167, 1196, 8, 37,··153.

where σ denotes the standard deviation and a the difference between the arithmetic mean of each combination and the arithmetic mean of the total. The results are shown in Table 5 and Fig. 2.

Table 5 a

Arithmetic means and standard deviation.   The case of female larva.

10 individuals		25 individuals		50 individuals		100 individuals	
212	226	221	224	518	220	221	220
222	215	215	211	225	222	221	220
228	236	226	207	218	221	225	218
209	227	225	213	224	218	222	223
210	226	215	208	225	222	217	220
219	224	220	220	225	225	221	223
224	224	222	222	225	222	218	220
232	229	226	214	219	214	218	222
221	232	222	219	225	218	221	224
214	221	228	219	222	225	219	220
234	225	223	209	223	222	218	220
215	229	227	225	220	219	223	220
215	223	220	225	221	220	221	219
225	229	230	224	209	223	221	223
226	219	220	224	210	223	220	222
218	226	219	222	221	227	223	222
226	216	225	221	224	219	217	220
219	230	225	220	219	221	223	224
226	227	225	219	218	216	219	220
217	206	218	225	221	218	223	218
231	217	225	221	214	220	2:3	222
212	222	221	226	222	223	218	220
201	210	227	225	224	219	219	223
214	210	213	217	222	219	221	221
237	207	217	224	223	219	219	218
221.5±8.2		221.2±5.2		221.1±3.0		221.0±2.0	

Table   5 a — continued

Arithmetic means and standard deviation.   The case of male larva.

10 individuals		25 individuals		50 individuals		100 individuals	
184	184	182	183	185	184	186	184
177	199	188	182	187	186	185	184
188	191	189	180	185	183	185	184
188	188	186	187	186	183	185	184
188	183	183	181	184	183	184	184
176	175	188	182	186	189	184	182
189	184	184	188	189	187	181	183
183	189	188	182	189	181	181	184

182	191	186	181	184	184	183	183
180	171	182	185	184	184	184	183
182	191	183	185	183	184	184	185
192	182	189	185	185	187	184	185
186	183	187	185	182	181	184	183
187	181	190	190	184	185	186	183
180	180	189	188	181	183	183	184
188	191	189	178	182	183	185	183
183	185	183	186	187	184	180	183
187	184	185	185	183	184	185	181
189	185	187	182	184	184	182	186
178	177	181	186	184	184	183	183
190	190	186	182	184	184	186	183
192	182	180	186	182	183	186	184
182	192	188	184	186	180	188	183
183	184	182	187	189	182	182	184
177	179	180	183	179	184	184	183
184.8±5.4		184.6±2.9		184.4±2.1		184.3±1.5	

Table   5 a — continued

Arithmetic means and standard deviation.   The case of female pupa.

10 individuals		25 individuals		50 individuals		100 individuals	
226	223	222	211	220	215	217	215
215	215	219	215	215	214	213	218
223	223	214	211	212	213	218	216
208	224	215	211	213	218	220	215
219	232	215	204	213	214	216	215
212	218	209	219	223	219	216	215
221	217	215	220	219	218	213	216
208	223	212	220	221	217	213	215
212	221	213	219	223	215	216	217
217	217	212	207	208	217	214	218
208	226	218	219	213	207	217	217
212	223	228	212	219	214	216	214
222	219	217	215	214	216	212	215
216	233	221	222	213	214	214	216
203	205	223	212	227	220	216	216
215	217	219	214	219	219	218	219
218	234	221	214	216	212	216	216
209	218	226	211	217	213	212	217
208	227	203	211	213	218	215	213
207	227	212	217	216	213	217	214

217	206	210	214	217	217	215	212
212	207	216	213	218	220	215	216
214	197	221	211	218	212	215	218
211	205	217	215	214	214	216	216
212	215	217	219	210	216	215	216

$$216.6 \pm 7.9 \qquad 215.7 \pm 5.0 \qquad 216.3 \pm 3.7 \qquad 216.0 \pm 1.8$$

Table 5 a — continued

Arithmetic means and standard deviation. The case of male pupa.

10 individuals		25 individuals		50 individuals		100 individuals	
166	158	160	162	153	158	157	158
165	156	154	152	157	160	163	158
154	160	157	158	161	151	161	159
160	156	158	157	164	160	160	158
150	154	160	163	160	157	159	160
153	159	160	158	161	159	156	154
165	163	152	162	158	159	150	160
161	153	156	152	162	161	160	159
151	165	159	156	159	160	156	157
159	157	160	161	159	159	158	158
163	157	157	161	158	159	155	157
154	162	156	155	155	161	156	158
160	163	160	160	160	155	157	159
167	151	159	161	158	160	157	162
155	162	159	162	160	160	158	158
154	169	159	154	159	154	159	155
149	156	163	153	154	161	160	165
156	160	160	158	158	158	159	157
156	160	160	156	159	161	158	157
156	164	159	159	157	153	160	161
155	165	159	160	154	157	158	158
161	158	160	157	157	159	159	160
161	157	161	159	161	158	155	157
164	163	157	159	151	157	159	157
155	155	160	156	157	157	157	157

$$159.0 \pm 4.5 \qquad 158.6 \pm 2.7 \qquad 158.7 \pm 2.6 \qquad 158.7 \pm 1.9$$

Table 5 b

Arithmetic means with the standard deviations of the 50 arithmetic means of the body weights of 1, 10. 25, 50 and 10 individuals.

Number of individuals	Larva		Pupa	
	Female	Male	Female	Male
1	221.0±21.5	184.2±15.7	216.3±19.9	158.6±11 7
10	221.5± 8.2	184.9± 5.4	216.6± 7.9	159.0± 4.5
25	221.2± 5.2	184.6± 2.9	215.7± 5.0	158.6± 2.7
50	221.1± 3.0	184.4± 2.1	216.3± 3.7	158.7± 2.6
100	221.0± 2.0	184.3± 1.5	216.0± 1.8	158.7± 1.9

Table 5 c

Standard deviation of arithmetic mean calculated employing $\sigma_m = \frac{\sigma}{\sqrt{m}}$.

		Larva		Pupa	
		Female	Male	Female	Male
m	σ	21.5	15.7	19.9	14.7
	10	6.9	4 9	6.3	1.7
	25	4.3	3.1	3.9	2.9
	50	3.0	2.2	2.8	2.0
	100	2.1	1.5	1.9	1.4
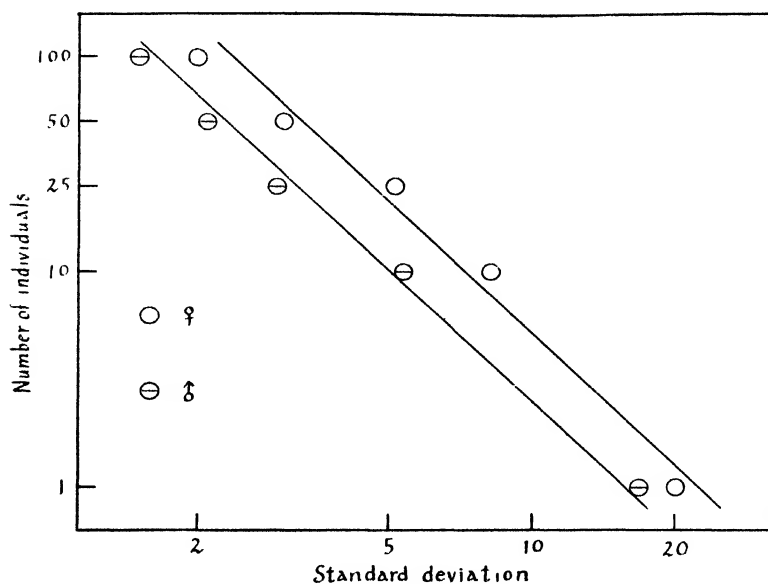
Fig. 2. Logarithmic graph showing the standard deviations of the arithmetic mean (σ_m) of the larval case. The deviation is represented against the number of individuals (m) on which the arithmetic mean is computed The straight lines are drawn according to $\sigma_m = \frac{\sigma}{\sqrt{m}}$, where $\sigma_♀ = 21.5$, $\sigma_♂ = 15.7$. ○&⊖ represent the result, which is actually computed on the arithmetic means.

<div align="center">III</div>

Let us now pass to the problem of the individual difference of the chronic change of the body weight. Generally speaking, the body weight of a living organism may be regarded as not to change during short time, and moreover, when the body weight changes, this change might occur at nearly the same degree for the individuals which are regarded as to belong to the same group. But, exactly speaking, the body weight must be regarded as almost always changing and the rate of the change must be different for all the individuals. Bearing these facts in mind, the following observations were carried out.

Material was obtained from Daizô. Body weight was measured, once every day in general, by every 0.2 mg, from the fourth sleep to a day before emergence. On the data thus obtained (Table 11), the rate of the change of body weight was calculated by several representative periods, and for each case the standard deviation of these ratios was computed (Table 6). In Table 7 are shown the frequency distributions of the ratios of the pupal cases.

The deviation of the ratio will be examined. It may generally be supposed that the nearer to 1 is the absolute value of the ratio, the less is the deviation, and in fact, at the sleeping period and the pupal stage, when the change of body weight is not remarkable, the standard deviation was lower than 0.5% of the ratio, while at the feeding period and also at the cocooning period, when the chronic change is great, the deviation amounted to about 5% of the ratio.

<div align="center">Table 6</div>

<div align="center">Ratios of the body weights in Table 11 with the standard deviations.</div>

During the fourth sleep

$\dfrac{\text{Oct. 31}}{\text{Oct. 30}}$	0.9747±0.0032
$\dfrac{\text{Novem. 1}}{\text{Oct. 31}}$	0.9713±0.0047
$\dfrac{\text{Novem. 2}}{\text{Novem. 1}}$	0.9394±0.0152

Fifth larval stage

$\dfrac{\text{May 15}}{\text{May 14}}$	1.463±0.062	1.00±0.042
$\dfrac{\text{May 18}}{\text{May 17}}$	1.295±0.057	1.00±0.044
$\dfrac{\text{May 18}}{\text{May 14}}$	3.864±0.203	1.00±0.052

Cocooning period

$\dfrac{\text{May 22}}{\text{May 18}}$	0.589±0.025	1.00±0.043

Pupal stage

$\dfrac{\text{May 23}}{\text{May 22}}$	0.9820±0.0043	1.000±0.0043
$\dfrac{\text{May 26}}{\text{May 25}}$	0.9936±0.0032	1.000±0.0032
$\dfrac{\text{May 30}}{\text{May 29}}$	0.9845±0.0013	1.000±0.0013
$\dfrac{\text{May 30}}{\text{May 22}}$	0.9291±0.0060	1.000±0.0064

Table 7

Frequency distributions of the ratios of the body weights.
Pupal cases

May 23 May 22		May 26 May 25		May 30 May 29	
Ratio	Frequency	Ratio	Frequency	Ratio	Frequency
0.969 ∣ 0.972	1	0.987 ∣ 0.988	2	0.983	7
0.973 ∣ 0.976	4	0.989 ∣ 0.990	12	0.984	9
0.977 ∣ 0.980	3	0.991 ∣ 0.992	15	0.985	7
0.981 ∣ 0.984	14	0.993 ∣ 0.994		0.986	5
0.985 ∣ 0.988	7	0.995 ∣ 0.996		0.987	2
0.989 ∣ 0.992	1	0.997 ∣ 0.998	1		

At the earlier period of the sleeping, the rate of the change of body weight is at variance with each other, and the range of deviation of ratio is as wide as those at the feeding period. This diversity is mainly caused by that it is difficult to discriminate whether a worm has really gone into sleep or not, and moreover, by that some one lays faeces after the beginning of sleep; even one piece of faeces has great influence upon the rate of the change of weight. Since the data given in Table 6 were obtained from the worms which have passed this unstable period, the ratios are within very narrow range of fluctuation. The same degree of diversity is found at the end of sleep, when ecdysis is in progress. The change of weight after ecdysis may be mainly effected by the loss of moisture from the surface of the newly exposed skin.

It is worth of notice that at the feeding period the range of the fluctuation of the ratio of body weights is nearly proportional to the magnitude of ratio in general (see Table 6). The influence of feeding and laying faeces upon the body weight will be mentioned in the following chapter.

It is expected that the deviation of the ratio at the cocooning period, especially that of daily change, must amount to high value, and in fact, even the ratio between the ripened worm and the newly pupated is 0.589 ± 0.025 or 1.00 ± 0.043, which is nearly equal to that at the feeding period. It is, however, almost impossible to determine for each individual the change of the body weight at this period, because, if a worm is disturbed in the middle of cocooning, the worm does not always resume to cocoon again. Therefore in the present paper some data will be given to show how the deviation is great

at this period (Table 8): Six worms were selected and weighed, which were regarded as to be at the same degree of ripening. Two worms were taken and weighed at each of the three following days respectively; since on the

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Table 8

Change of body weight during the cocooning period.

Weights in gm

</div>

No.	Oct. 23 Ripened	Oct. 24 Thin cocoon	Oct. 24 / Oct. 23	Oct. 25 Cocooning not yet complete	Oct. 25 / Oct. 24	Oct. 26 Cocooning Complete	Oct. 26 / Oct. 25	Oct. 27 Pupated	Oct. 27 / Oct. 26	Oct. 27 / Oct. 23
1	2.7725	2.1505	0.7756							
2	2.4455	1.5385	0.6291							
3	2.0770			1.3285	0.6396					
4	2.9630			1.5755	0.5317					
5	2.0580					1.0060	0.4888	0.9363	0.9307	0.4550
6	2.4330					1.1685	0.4802	1.1365	0.9726	0.4671

fourth day cocooning was completed, the same worms were weighed once again on the fifth day. On examining the result, we can see the degree of the deviation at this period; during cocooning, the ratios are highly at variance with each other, the ratios between the data on 23/X and 24/X being 0.7756, and 0.6291 respectively, and the difference between the two ratios 0.1465, amounting to nearly 20% of the ratios. The ratio between 25/X and 24/X also amounts to nearly the same degree. After the completion of cocooning, the difference becomes less, decreasing to less than $\frac{1}{5}$ of those before the completion. Since the deviation of the ratio between the early day and the later of the cocooning period appears to be less than the ratios between the values of earlier days, the high deviation in the middle of cocooning must mainly be caused by the individual difference of the velocity of cocooning.

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IV

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As already mentioned above, the body weight of a living organism must be ragarded as always changing. As a practical affair, however, this change of the body weight is so slight that we can assume that an organism remains at a constant body weight for certain short time. But the influence of food and excreta can not be neglected. The weight of food and excreta, which might not be a proper component of a living organism, has a considerable influence upon the body weight. However, it may be useless to try to decide which of the two values is truer, one measured just before and one after excretion or taking food. Both of these two must equally be true. Therefore, as a practical affair, we must bear in mind that such a value as the body weight is always accompanied by some deviation, which is caused by food and

excreta. In Table 9 are shown some examples of the fifth stage. The change of the body weight during about 20 minutes has the deviation which varies between -0.008 and $+0.035$ gm, i. e., the deviation amounts, in an extreme case, to about 3% of the body weight. Here the weight of a piece of faeces amounts to about 1% of the weight.

Table 9

Change of body weight during short time at the feeding period.
Weights in gm

Measurements by every 20 minutes.

No. of individual	1[1]	2[2]	(2, 1)
1	1.6578	1.6478	- 0.0100
2	1.7862	1.7852	0.0010
3	1.7734	1.7832	+0.0098
4	1.6524	1.6666	+0.0142
5	1.5926	1.6048	+0.0122
6	1.7212	1.7132	−0.0080
7	1.8222	1.8274	+0.0052
8	1.7934	1.8126	+0.0192
9	1.7860	1.7916	+0.0056
10	1.6896	1.7010	+0.0014

No. of individual	1	2	(2)—(1)	3	(3)—(2)	4	(4)—(3)
1	1.3522	1.3566	+0.0044	1.3664	+0.0098	1.3864	+0.0200
2	1.4212	1.4210	−0.0002	1.4342	+0.0132	1.4592	+0.0250
3	1.4052	1.4406	+0.0354	1.4480	+0.0074	1.4732	+0.0252
4	1.3620	1.3760	+0.0140	1.3794	+0.0034	1.3714	−0.0080
5	1.3350	1.3406	+0.0056	1.3718	+0.0312	1.3730	+0.0012
6	1.2274	1.2284	+0.0010	1.2474	+0.0190	1.2588	+0.0114
7	1.3702	1.3908	+0.0206	1.4076	+0.0168	1.4170	+0.0094
8	1.4184	1.4252	+0.0068	1.4472	+0.0220	1.4386	−0.0086
9	1.3854	1.3954	+0.0100	1.4034	+0.0080	1.4086	+0.0052
10	1.3734	1.3604	−0.0130	1.3828	+0.0224	1.3844	+0.0016

Table 9 — continued

Weight of faecal mass in the case I.

0.0098	0.0108		
0.0170	0.0102		
0.0102	0.0170	Average	0.012
0.0102 ·	0.0136		
0.0120	0.0160		
0.0097	0.0124		
0.0112			

Weights of faecal mass in the case II.

0.0084	0.0088		
0.0140	0.0084		
0.0084	0.0140		
0.0084	0.0112	Average	0.010
0.0100	0.0132		
0.0080	0.0104		
0.0092			

SUMMARY

1. The Quetelet's formula can safely be applied to the body weight of the silkworm.

2. When the standard deviation of arithmetic mean (σ_m) is computed from the standard deviation (σ), the precision of σ_m depends upon the precision of σ; in the case of male larva, $\sigma_m = \frac{15.0 \pm 1.6}{\sqrt{m}}$, where σ is computed on 50 individuals. (Average body weight 181 cg).

3. σ_m's computed on 50 combinations of 1, 10, 25, 50 and 100 individuals, in the case of female larva for example, are 21.5, 8.2, 5.2, 3.0 and 2.0 respectively. And σ_m's computed using $\sigma_m = \frac{\bar{\sigma}}{\sqrt{m}}$ ($\bar{\sigma}$ is computed on 750 individuals) are, in the same case, 21.5 ($= \bar{\sigma}$), 6.9, 4.3, 3.0 and 2.1 respectively. (Average body weight 221 cg).

4. Individual difference of the chronic change of the body weight was observed from the fourth sleep to a day before emergence. At the sleeping period and the pupal stage, the standard deviation of the ratio between the daily observations was lower than 0.5% of the ratio, while at the feeding period and the cocooning period, the deviation was about 5% of the ratio.

The daily change at the earlier days of the cocooning period appears to show the greatest deviation.

5. The change of the body weight during about 20 minutes at the feeding period of the fifth larval stage, showed the deviation which varied between about -0.008 and $+0.035$ gm, about 3% in an extreme case of the body weight. This deviation is, of course, caused by feeding and excretion.

Table 10 a
Female larva

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
1	235	40	225	79	235	118	185	157	180
2	215	41	155	80	260	119	210	158	235
3	225	42	240	81	245	120	235	159	225
1	200	43	225	82	220	121	180	160	215
5	195	11	230	83	215	122	265	161	220
6	215	45	210	84	250	123	185	162	215
7	215	46	205	85	225	124	150	163	225
8	220	47	240	86	200	125	215	164	220
9	210	18	240	87	195	126	195	165	230
10	190	49	215	88	235	127	245	166	245
11	230	50	190	89	275	128	225	167	250
12	230	51	240	90	250	129	210	168	225
13	205	52	245	91	210	130	235	169	200
14	220	53	220	92	175	131	245	170	210
15	260	54	185	93	225	132	225	171	220
16	255	55	200	94	195	133	210	172	215
17	230	56	200	95	225	134	220	173	260
18	210	57	250	96	175	135	255	174	220
19	185	58	240	97	225	136	190	175	205
20	240	59	225	98	215	137	240	176	225
21	235	60	225	99	215	138	230	177	270
22	220	61	225	100	230	139	245	178	195
23	230	62	215	101	200	140	200	179	260
21	240	63	215	102	245	141	160	180	220
25	220	61	245	103	240	142	170	181	200
26	175	65	230	104	230	143	250	182	230
27	225	66	200	105	225	111	215	183	230
28	235	67	260	106	235	145	225	184	215
29	235	68	220	107	210	116	220	185	210
30	200	69	235	108	225	147	235	186	170
31	200	70	240	109	210	148	240	187	265
32	215	71	210	110	250	149	215	188	250
33	250	72	250	111	170	150	215	189	220
34	220	73	195	112	210	151	255	190	220
35	200	74	230	113	230	152	210	191	240
36	220	75	250	114	200	153	220	192	180
37	240	76	240	115	235	154	220	193	230
38	235	77	275	116	215	155	230	194	225
39	220	78	215	117	240	156	205	195	245

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
196	210	240	220	284	180	328	235	372	225
197	225	241	225	285	245	329	195	373	255
198	240	242	240	286	195	330	225	374	225
199	215	243	245	287	235	331	250	375	200
200	230	244	205	288	220	332	220	376	215
201	220	245	225	289	205	333	215	377	220
202	195	246	235	290	230	334	215	378	225
203	220	247	265	291	235	335	260	379	240
204	190	248	245	292	240	336	225	380	210
205	230	249	240	293	210	337	245	381	185
206	220	250	245	294	230	338	240	382	235
207	215	251	230	295	250	339	240	383	220
208	230	252	215	296	270	340	235	384	215
209	200	253	240	297	225	341	230	385	240
210	200	254	235	298	230	342	260	386	250
211	260	255	235	299	215	343	240	387	230
212	270	256	235	300	210	344	240	388	215
213	240	257	225	301	200	345	185	389	215
214	230	258	245	302	190	346	245	390	220
215	200	259	230	303	225	347	225	391	225
216	220	260	230	304	230	348	235	392	205
217	210	261	230	305	245	349	220	393	190
218	250	262	235	306	210	350	210	394	215
219	200	263	215	307	215	351	240	395	155
220	240	264	215	308	230	352	185	396	230
221	235	265	240	309	200	353	200	397	220
222	220	266	185	310	200	354	235	398	235
223	240	267	240	311	240	355	220	399	230
224	215	268	210	312	165	356	225	400	245
225	205	269	225	313	245	357	230	401	215
226	250	270	210	314	235	358	235	402	225
227	225	271	220	315	220	359	220	403	220
228	225	272	200	316	240	360	240	404	240
229	245	273	205	317	250	361	190	405	235
230	235	274	240	318	235	362	250	406	240
231	210	275	205	319	220	363	225	407	200
232	240	276	190	320	205	364	225	408	240
233	225	277	245	321	205	365	260	409	230
234	205	278	225	322	220	366	210	410	245
235	225	279	235	323	215	367	190	411	255
236	220	280	250	324	215	368	200	412	230
237	190	281	235	325	230	369	210	413	215
238	220	282	210	326	235	370	195	414	220
239	210	283	260	327	225	371	215	415	225

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
416	225	460	260	504	220	548	215	592	215
417	230	461	225	505	260	549	235	593	215
418	260	462	225	506	205	550	220	594	215
419	185	463	225	507	230	551	235	595	190
420	225	464	220	508	220	552	225	596	235
421	215	465	230	509	235	553	205	597	230
422	215	466	200	510	230	554	240	598	205
423	180	467	240	511	210	555	225	599	190
424	250	468	225	512	245	556	235	600	215
425	215	469	245	513	215	557	250	601	175
426	195	470	225	514	220	558	229	602	215
427	240	471	260	515	255	559	195	603	230
428	245	472	240	516	240	560	235	604	225
429	270	473	210	517	215	561	250	605	230
430	230	474	220	518	220	562	225	606	220
431	205	475	185	519	245	563	215	607	240
432	270	476	240	520	200	564	245	608	205
433	200	477	205	521	200	565	270	609	220
434	245	478	235	522	235	566	235	610	210
435	230	479	220	523	195	567	205	611	240
436	220	480	215	524	230	568	200	612	210
437	230	481	215	525	250	569	210	613	245
438	155	482	225	526	240	570	240	614	175
439	180	483	240	527	230	571	265	615	225
440	255	484	240	528	235	572	220	616	205
441	220	485	195	529	240	573	165	617	235
442	200	486	200	530	245	574	260	618	215
443	275	487	230	531	200	575	225	619	220
444	240	488	180	532	245	576	200	620	200
445	225	489	235	533	195	577	235	621	195
446	220	490	225	534	240	578	230	622	210
447	180	491	215	535	185	579	235	623	245
448	255	492	195	536	200	580	225	624	235
449	225	493	185	537	240	581	230	625	215
450	235	494	220	538	220	582	215	626	210
451	245	495	225	539	205	583	215	627	225
452	225	496	220	540	225	584	210	628	200
453	195	497	210	541	230	585	180	629	225
454	220	498	250	542	245	586	180	630	220
455	225	499	205	543	195	587	200	631	235
456	235	500	235	544	225	588	235	632	255
457	220	501	235	545	220	589	180	633	240
458	220	502	205	546	210	590	220	634	210
459	220	503	230	547	195	591	225	635	225

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
636	215	659	215	682	215	705	205	728	190
637	215	660	205	683	230	706	215	729	220
638	230	661	220	684	200	707	190	730	190
639	240	662	200	685	225	708	195	731	210
640	250	663	170	686	180	709	220	732	225
641	225	664	200	687	245	710	225	733	220
642	230	665	210	688	180	711	190	734	195
643	220	666	205	689	200	712	225	735	200
644	185	667	240	690	195	713	205	736	190
645	240	668	260	691	215	714	225	737	200
646	210	669	205	692	210	715	210	738	210
647	205	670	215	693	195	716	215	739	230
648	240	671	230	694	160	717	200	740	195
649	230	672	210	695	235	718	225	741	220
650	235	673	160	696	190	719	235	742	215
651	195	674	210	697	180	720	200	743	195
652	210	675	230	698	220	721	220	744	200
653	225	676	220	699	200	722	215	745	215
654	210	677	220	700	210	723	240	746	220
655	220	678	235	701	235	724	235	747	200
656	230	679	200	702	195	725	195	748	245
657	215	680	190	703	220	726	220	749	180
658	205	681	235	704	205	727	215	750	205

Table   10 b
Male larva

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
1	200	16	185	31	170	46	195	61	180
2	200	17	170	32	205	47	200	62	190
3	190	18	200	33	180	48	200	63	165
4	170	19	175	34	200	49	195	64	170
5	195	20	150	35	200	50	180	65	195
6	165	21	210	36	220	51	200	66	180
7	195	22	145	37	165	52	165	67	190
8	160	23	200	38	190	53	210	68	200
9	180	24	185	39	160	54	175	69	185
10	180	25	190	40	195	55	160	70	195
11	175	26	185	41	175	56	185	71	225
12	180	27	220	42	210	57	190	72	185
13	195	28	160	43	195	58	195	73	170
14	165	29	190	44	185	59	225	74	210
15	190	30	155	45	190	60	175	75	205

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
76	185	120	180	164	195	208	220	252	190
77	210	121	195	165	200	209	205	253	185
78	170	122	180	.166	190	210	185	254	170
79	190	123	145	167	170	211	165	255	185
80	185	124	150	168	225	212	195	256	165
81	190	125	200	169	210	213	175	257	185
82	175	126	165	170	195	214	200	258	170
83	180	127	200	171	180	215	160	259	195
84	195	128	200	172	175	216	190	260	170
85	205	129	175	173	165	217	195	261	195
86	180	130	195	174	180	218	180	262	175
87	175	131	170	175	175	219	165	263	175
88	155	132	165	176	185	220	185	264	200
89	185	133	210	177	165	221	180	265	190
90	185	134	205	178	200	222	205	266	185
91	200	135	175	179	160	223	200	267	190
92	195	136	195	180	165	224	195	268	180
93	170	137	195	181	170	225	190	269	195
94	185	138	195	182	150	226	160	270	175
95	180	139	185	183	195	227	185	271	210
96	190	140	190	184	210	228	190	272	205
97	205	141	180	185	170	229	175	273	190
98	170	142	195	186	175	230	195	274	185
99	195	143	190	187	190	231	205	275	170
100	200	144	180	188	210	232	175	276	175
101	145	145	170	189	235	233	170	277	170
102	175	146	195	190	205	234	190	278	220
103	205	147	205	191	185	235	195	279	175
104	160	148	190	192	215	236	190	280	200
105	195	149	190	193	180	237	180	281	170
106	190	150	190	194	170	238	205	282	195
107	175	151	190	195	190	239	180	283	205
103	195	152	185	196	200	210	180	284	180
109	200	153	160	197	220	241	160	285	190
110	190	154	190	198	185	242	180	286	180
111	190	155	170	199	185	243	190	287	195
112	210	156	220	200	185	244	170	288	190
113	210	157	190	201	185	245	180	289	200
114	180	158	170	202	190	246	180	290	180
115	190	159	180	203	175	247	180	291	155
116	170	160	180	204	180	248	170	292	175
117	185	161	170	205	190	249	195	293	160
118	175	162	175	206	180	250	180	294	205
119	185	163	170	207	180	251	155	295	180

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
296	175	340	210	384	185	428	175	472	195
297	215	341	190	385	160	429	195	473	210
298	160	342	190	386	170	430	190	474	200
299	185	343	190	387	215	431	155	475	180
300	190	344	165	388	225	432	200	476	185
301	170	345	220	389	155	433	185	477	150
302	195	346	195	390	200	434	160	478	180
303	215	347	180	391	180	435	175	479	205
304	160	348	200	392	195	436	185	480	185
305	210	349	205	393	190	437	180	481	170
306	175	350	210	394	175	438	195	482	185
307	180	351	205	395	180	439	205	483	165
308	190	352	195	396	205	440	185	484	150
309	180	353	190	397	180	441	205	485	195
310	190	354	190	398	190	442	190	486	175
311	180	355	185	399	200	443	215	487	190
312	180	356	185	400	180	444	185	488	185
313	185	357	185	401	180	445	195	489	190
314	180	358	195	402	175	446	195	490	185
315	195	359	170	403	175	447	220	491	190
316	195	360	185	404	170	448	165	492	205
317	195	361	185	405	180	449	175	493	155
318	165	362	200	406	190	450	160	494	190
319	205	363	200	407	180	451	165	495	185
320	190	364	200	408	195	452	175	496	195
321	200	365	195	409	180	453	170	497	190
322	170	366	185	410	200	454	185	498	175
323	180	367	190	411	200	455	185	499	185
324	225	368	205	412	175	456	205	500	165
325	175	369	180	413	190	457	175	501	180
326	180	370	180	414	190	458	200	502	190
327	190	371	170	415	190	459	190	503	180
328	190	372	200	416	185	460	185	504	180
329	175	373	185	417	160	461	190	505	210
330	190	374	205	418	170	462	175	506	180
331	175	375	160	419	180	463	205	507	155
332	175	376	205	420	180	464	205	508	175
333	195	377	185	421	170	465	190	509	185
334	180	378	190	422	195	466	160	510	180
335	220	379	215	423	200	467	175	511	180
336	180	380	195	424	200	468	210	512	185
337	180	381	170	425	180	469	205	513	170
338	195	382	185	426	175	470	165	514	205
339	185	383	200	427	180	471	175	515	195

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
516	190	560	175	604	165	648	180	692	175
517	195	561	165	605	195	649	185	693	180
518	190	562	210	606	190	650	185	694	170
519	220	563	185	607	185	651	165	695	190
520	185	564	190	608	170	652	180	696	175
521	190	565	205	609	195	653	210	697	190
522	180	566	195	610	175	654	160	698	180
523	175	567	220	611	190	655	175	699	190
524	185	568	200	612	175	656	145	700	170
525	200	569	210	613	170	657	175	701	150
526	160	570	200	614	175	658	180	702	155
527	180	571	200	615	170	659	195	703	165
528	160	572	185	616	195	660	210	704	165
529	190	573	195	617	185	661	195	705	180
530	170	574	190	618	185	662	205	706	175
531	180	575	190	619	170	663	180	707	190
532	170	576	180	620	185	664	185	708	150
533	210	577	195	621	180	665	155	709	165
534	185	578	170	622	170	666	165	710	185
535	170	579	180	623	160	667	170	711	160
536	205	580	195	624	180	668	160	712	180
537	180	581	205	625	185	669	195	713	180
538	155	582	205	626	175	670	155	714	180
539	175	583	200	627	215	671	170	715	190
540	180	584	175	628	200	672	160	716	180
541	180	585	180	629	175	673	200	717	170
542	195	586	185	630	170	674	185	718	165
543	195	587	185	631	195	675	170	719	185
544	180	588	170	632	175	676	165	720	155
545	170	589	180	633	190	677	190	721	190
546	205	590	180	634	180	678	170	722	195
547	165	591	165	635	185	679	170	723	185
548	190	592	170	636	195	680	175	724	185
549	170	593	180	637	195	681	150	725	175
550	185	594	215	638	185	682	175	726	180
551	190	595	150	639	175	683	180	727	180
552	200	596	180	640	190	684	160	728	170
553	165	597	200	641	175	685	155	729	180
554	175	598	175	642	180	686	145	730	210
555	170	599	185	643	185	687	170	731	175
556	185	600	160	644	190	688	160	732	180
557	175	601	185	645	170	689	160	733	170
558	180	602	190	646	165	690	175	734	195
559	150	603	180	647	180	691	175	735	210

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
736	170	739	165	742	175	745	155	748	180
737	185	740	185	743	170	746	205	749	185
738	175	741	175	744	185	747	180	750	195

Table 10 c
Female pupa

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
1	225	36	240	71	220	106	200	141	215
2	230	37	230	72	185	107	190	142	230
3	205	38	210	73	250	108	240	143	225
4	225	39	215	74	200	109	225	144	165
5	225	40	210	75	165	110	185	145	215
6	255	41	195	76	210	111	205	146	205
7	240	42	235	77	220	112	205	147	195
8	215	43	220	78	185	113	215	148	190
9	235	44	220	79	210	114	200	149	195
10	210	45	220	80	240	115	240	150	200
11	230	46	250	81	205	116	210	151	205
12	205	47	225	82	185	117	230	152	225
13	190	48	205	83	235	118	195	153	240
14	220	49	225	84	210	119	210	154	215
15	210	50	200	85	225	120	215	155	205
16	170	51	255	86	230	121	230	156	200
17	220	52	170	87	225	122	260	157	190
18	270	53	200	88	200	123	210	158	220
19	210	54	190	89	170	124	235	159	230
20	200	55	200	90	240	125	235	160	220
21	250	56	260	91	235	126	225	161	205
22	200	57	240	92	220	127	200	162	205
23	235	58	200	93	235	128	225	163	240
24	200	59	190	94	215	129	170	164	220
25	245	60	215	95	240	130	230	165	205
26	265	61	210	96	205	131	175	166	190
27	160	62	240	97	215	132	190	167	245
28	205	63	215	98	225	133	205	168	220
29	210	64	235	99	200	134	205	169	215
30	260	65	215	100	205	135	270	170	235
31	230	66	190	101	205	136	265	171	220
32	210	67	230	102	200	137	225	172	200
33	210	68	210	103	220	138	200	173	235
34	215	69	210	104	215	139	205	174	185
35	210	70	240	105	205	140	220	175	205

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
176	220	220	210	264	225	308	230	352	245
177	185	221	230	265	220	309	220	353	200
178	205	222	205	266	200	310	220	354	220
179	215	223	210	267	195	311	200	355	240
180	225	224	210	268	225	312	210	356	220
181	235	225	200	269	225	313	225	357	215
182	200	226	215	270	225	314	205	358	230
183	210	227	215	271	240	315	200	359	215
184	205	228	215	272	195	316	230	360	235
185	175	229	215	273	240	317	210	361	220
186	225	230	225	274	230	318	230	362	245
187	215	231	190	275	190	319	240	363	255
188	200	232	220	276	235	320	215	364	220
189	200	233	205	277	255	321	225	365	205
190	215	234	230	278	205	322	235	366	210
191	190	235	215	279	230	323	215	367	230
192	220	236	200	280	210	324	195	368	195
193	205	237	210	281	235	325	225	369	235
194	220	238	240	282	245	326	220	370	215
195	205	239	180	283	210	327	215	371	200
196	205	240	225	284	230	328	245	372	255
197	190	241	230	285	225	329	240	373	235
198	185	242	225	286	215	330	220	374	195
199	230	243	205	287	215	331	255	375	215
200	225	244	210	288	245	332	225	376	215
201	205	245	195	289	200	333	240	377	210
202	245	246	190	290	225	334	205	378	235
203	185	247	235	291	235	335	235	379	245
204	235	248	225	292	220	336	200	380	190
205	205	249	190	293	240	337	225	381	215
206	195	250	220	294	230	338	195	382	225
207	190	251	210	295	230	339	230	383	230
208	250	252	235	296	215	340	205	384	235
209	230	253	235	297	210	341	205	385	220
210	230	254	245	298	280	342	215	386	225
211	250	255	240	299	210	343	225	387	220
212	205	256	215	300	255	344	210	388	210
213	220	257	205	301	200	345	220	389	295
214	215	258	190	302	230	346	195	390	255
215	200	259	225	303	210	347	195	391	200
216	225	260	230	304	205	348	250	392	205
217	205	261	210	305	210	349	210	393	205
218	205	262	230	306	235	350	250	394	185
219	185	263	200	307	220	351	240	395	215

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
396	200	440	235	484	220	528	200	572	235
397	215	441	215	485	195	529	190	573	155
398	205	442	250	486	215	530	260	574	245
399	205	443	220	487	240	531	240	575	215
400	220	444	190	488	240	532	215	576	175
401	225	445	230	489	195	533	205	577	240
402	225	446	200	490	150	534	240	578	215
403	230	447	260	491	235	535	210	579	190
404	210	448	220	492	205	536	215	580	230
405	225	449	215	493	185	537	220	581	205
406	190	450	270	494	210	538	240	582	250
407	230	451	210	495	235	539	240	583	215
408	220	452	190	496	230	540	230	584	235
409	205	453	165	497	220	541	215	585	240
410	210	454	175	498	210	542	190	586	225
411	245	455	205	499	215	543	205	587	220
412	200	456	220	500	210	544	240	588	215
413	245	457	230	501	205	545	160	589	200
414	220	458	215	502	205	546	215	590	230
415	275	459	240	503	245	547	215	591	215
416	235	460	215	504	215	548	215	592	235
417	215	461	220	505	240	549	240	593	230
418	275	462	155	506	225	550	200	594	205
419	210	463	210	507	250	551	210	595	225
420	220	464	190	508	195	552	205	596	205
421	200	465	165	509	225	553	225	597	185
422	200	466	195	510	195	554	235	598	220
423	225	467	235	511	235	555	205	599	225
424	215	468	230	512	230	556	215	600	210
425	215	469	225	513	150	557	225	601	240
426	250	470	250	514	210	558	215	602	260
427	220	471	220	515	195	559	200	603	200
428	225	472	165	516	160	560	240	604	250
429	215	473	180	517	215	561	280	605	235
430	215	474	195	518	165	562	235	606	250
431	220	475	195	519	195	563	225	607	220
432	210	476	220	520	230	564	170	608	220
433	225	477	245	521	225	565	195	609	175
434	235	478	210	522	215	566	215	610	235
435	245	479	250	523	205	567	235	611	220
436	235	480	195	524	215	568	275	612	210
437	230	481	200	525	210	569	195	613	190
438	220	482	195	526	205	570	230	614	210
439	215	483	195	527	210	571	245	615	210

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
616	220	656	150	696	195	736	195	776	215
617	225	657	225	697	190	737	200	777	215
618	210	658	235	698	225	738	190	778	220
619	195	659	215	699	225	739	230	779	185
620	230	660	220	700	220	740	165	780	235
621	225	661	220	701	215	741	225	781	215
622	180	662	175	702	230	742	195	782	200
623	235	663	210	703	250	743	220	783	235
624	195	664	230	704	185	744	160	784	185
625	190	665	265	705	220	745	1˙0	785	240
626	230	666	225	706	220	746	230	786	240
627	225	667	230	707	220	747	215	787	230
628	210	668	210	708	200	748	230	788	210
629	205	669	245	709	195	749	205	789	220
630	230	670	180	710	215	750	155	790	205
631	185	671	185	711	185	751	250	791	225
632	240	672	210	712	240	752	220	792	230
633	165	673	225	713	220	753	205	793	170
634	210	674	200	714	180	754	215	794	205
635	215	675	220	715	180	755	195	795	250
636	240	676	180	716	215	756	235	796	225
637	225	677	185	717	240	757	180	797	245
638	215	678	205	718	185	758	230	798	225
639	225	679	195	719	190	759	215	799	230
640	235	680	235	720	210	760	220	800	245
641	220	681	240	721	205	761	220	801	185
642	155	682	215	722	230	762	220	802	240
643	215	683	200	723	215	763	225	803	185
644	200	684	225	724	230	764	240	804	215
645	195	685	210	725	210	765	200	805	235
646	205	686	225	726	210	766	190	806	265
647	210	687	250	727	220	767	205	807	220
648	190	688	150	728	205	768	230	808	200
649	200	689	223	729	260	769	255	809	210
650	230	690	190	730	220	770	240	810	195
651	180	691	230	731	210	771	245	811	240
652	220	692	220	732	210	772	215	812	195
653	165	693	180	733	180	773	215	813	235
654	220	694	225	734	230	774	185		
655	215	695	235	735	175	775	210		

Table   10 d
Male pupa

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
1	185	41	155	81	160	121	160	161	165
2	170	42	140	82	150	122	165	162	165
3	150	43	165	83	170	123	165	163	160
4	165	44	155	84	155	124	160	164	145
5	185	45	135	85	150	125	170	165	140
6	170	46	135	86	150	126	140	166	120
7	170	47	165	87	145	127	145	167	140
8	170	48	140	88	170	128	180	168	165
9	155	49	160	89	145	129	160	169	130
10	145	50	155	90	120	130	160	170	165
11	170	51	140	91	160	131	155	171	145
12	175	52	165	92	170	132	215	172	160
13	165	53	165	93	160	133	150	173	155
14	150	54	160	94	170	134	190	174	165
15	165	55	180	95	165	135	150	175	155
16	125	56	140	96	150	136	155	176	145
17	140	57	160	97	135	137	155	177	145
18	150	58	140	98	135	138	155	178	160
19	180	59	165	99	175	139	180	179	165
20	130	60	120	100	170	140	160	180	165
21	150	61	170	101	155	141	150	181	155
22	150	62	150	102	170	142	170	182	155
23	165	63	165	103	160	143	145	183	140
24	175	64	140	104	170	144	175	184	180
25	160	65	170	105	155	145	150	185	145
26	160	66	150	106	155	146	165	186	155
27	130	67	195	107	165	147	140	187	155
28	170	68	180	108	185	148	145	188	170
29	115	69	165	109	160	149	165	189	145
30	140	70	170	110	160	150	145	190	160
31	155	71	150	111	150	151	150	191	155
32	165	72	135	112	155	152	155	192	150
33	160	73	145	113	155	153	160	193	160
34	150	74	180	114	130	154	150	194	155
35	170	75	140	115	155	155	175	195	145
36	140	76	180	116	145	156	135	196	155
37	165	77	165	117	175	157	145	197	160
38	185	78	150	118	155	158	125	198	170
39	165	79	195	119	170	159	185	199	165
40	150	80	170	120	155	160	160	200	145

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
201	155	245	140	289	200	333	175	377	170
202	125	246	170	290	160	334	150	378	165
203	165	247	170	291	160	335	145	379	150
204	145	248	145	292	150	336	205	380	175
205	180	249	180	293	150	337	160	381	135
206	140	250	170	294	170	338	170	382	165
207	165	251	170	295	170	339	185	383	155
208	170	252	160	296	135	340	145	384	155
209	155	253	165	297	150	341	160	385	150
210	155	254	150	298	160	342	155	386	150
211	165	255	165	299	140	343	145	387	165
212	175	256	165	300	160	344	180	388	140
213	140	257	135	301	155	345	180	389	190
214	170	258	145	302	125	346	150	390	135
215	170	259	175	303	170	347	155	391	160
216	175	260	155	304	170	348	150	392	145
217	150	261	160	305	175	349	155	393	155
218	165	262	160	306	175	350	145	394	150
219	140	263	140	307	145	351	165	395	170
220	165	264	155	308	160	352	155	396	160
221	185	265	185	309	150	353	170	397	180
222	165	266	155	310	170	354	145	398	150
223	165	267	140	311	170	355	170	399	160
224	160	268	155	312	170	356	170	400	190
225	145	269	155	313	150	357	165	401	205
226	165	270	155	314	155	358	145	402	190
227	165	271	170	315	155	359	155	403	170
228	170	272	145	316	200	360	135	404	120
229	160	273	170	317	150	361	170	405	155
230	160	274	145	318	150	362	145	406	160
231	160	275	165	319	160	363	185	407	180
232	165	276	185	320	175	364	175	408	185
233	180	277	155	321	150	365	170	409	165
234	135	278	155	322	150	366	140	410	160
235	135	279	150	323	160	367	145	411	130
236	185	280	160	324	155	368	150	412	180
237	175	281	145	325	160	369	185	413	185
238	170	282	155	326	160	370	160	414	125
239	170	283	140	327	145	371	160	415	155
240	165	284	135	328	145	372	175	416	145
241	135	285	170	329	165	373	160	417	170
242	140	286	180	330	140	374	160	418	150
243	140	287	140	331	160	375	140	419	150
244	160	288	140	332	160	376	175	420	170

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
421	155	465	150	509	180	553	160	597	165
422	170	466	160	510	155	554	170	598	160
423	165	467	180	511	170	555	150	599	155
424	160	468	160	512	160	556	160	600	125
425	180	469	150	513	130	557	155	601	150
426	150	470	145	514	145	558	175	602	160
427	145	471	170	515	165	559	170	603	160
428	170	472	160	516	160	560	155	604	150
429	145	473	150	517	205	561	160	605	160
430	160	474	150	518	155	562	185	606	180
431	175	475	145	519	160	563	160	607	185
432	180	476	150	520	150	564	165	608	135
433	140	477	145	521	160	565	180	609	130
434	160	478	160	522	190	566	145	610	160
435	155	479	175	523	150	567	165	611	140
436	165	480	165	524	150	568	155	612	205
437	155	481	165	525	100	569	160	613	165
438	155	482	170	526	165	570	160	614	175
439	165	483	150	527	155	571	170	615	155
440	150	484	165	528	180	572	170	616	135
441	160	485	155	529	135	573	170	617	175
442	160	486	160	530	155	574	160	618	160
443	145	487	155	531	145	575	145	619	145
444	170	488	160	532	145	576	160	620	150
445	160	489	165	533	175	577	190	621	155
446	135	490	190	534	170	578	155	622	155
447	135	491	160	535	140	579	140	623	180
448	185	492	155	536	150	580	185	624	160
449	145	493	175	537	170	581	150	625	175
450	145	494	125	538	160	582	170	626	155
451	150	495	175	539	180	583	130	627	165
452	145	496	150	540	140	584	135	628	140
453	150	497	150	541	145	585	130	629	150
454	205	498	130	542	150	586	185	630	145
455	195	499	175	543	115	587	155	631	120
456	160	500	160	544	190	588	140	632	180
457	180	501	170	545	170	589	160	633	160
458	165	502	170	546	175	590	160	634	185
459	135	503	155	547	170	591	145	635	150
460	170	504	145	548	160	592	160	636	190
461	175	505	165	549	185	593	170	367	155
462	160	506	155	550	150	594	175	368	185
463	150	507	130	551	150	595	170	639	185
464	155	508	145	552	130	596	155	640	170

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
641	140	685	150	729	165	773	170	817	115
642	175	686	150	730	170	774	125	818	155
643	170	687	140	731	155	775	155	819	160
644	145	688	165	732	160	776	195	820	155
645	175	689	165	733	160	777	170	821	150
646	165	690	175	734	145	778	150	822	140
647	160	691	170	735	160	779	150	823	155
648	160	692	155	736	170	780	185	824	160
649	175	693	165	737	155	781	170	825	110
650	150	694	170	738	170	782	155	826	155
651	150	695	195	739	180	783	155	827	150
652	150	696	130	740	165	784	180	828	135
653	140	697	190	741	195	785	150	829	140
654	145	698	150	742	145	786	210	830	160
655	145	699	150	743	160	787	150	831	160
656	160	700	135	744	190	788	165	832	145
657	135	701	165	745	140	789	140	833	185
658	165	702	140	746	165	790	150	834	130
659	155	703	150	747	145	791	150	835	155
660	130	704	190	748	150	792	150	836	125
661	185	705	155	749	170	793	170	837	145
662	120	706	160	750	185	794	150	838	180
663	145	707	140	751	150	795	170	839	160
664	155	708	155	752	165	796	160	840	155
665	155	709	165	753	135	797	115	841	140
666	165	710	165	754	160	798	170	842	165
667	170	711	160	755	155	799	170	843	165
668	175	712	125	756	140	800	160	844	170
669	135	713	145	757	175	801	155	845	175
670	160	714	165	758	170	802	150	846	175
671	140	715	130	759	175	803	155	847	190
672	165	716	170	760	140	804	150	848	140
673	165	717	155	761	160	805	175	849	145
674	165	718	160	762	135	806	165	850	160
675	140	719	180	763	150	807	145	851	110
676	165	720	160	764	175	808	170	852	135
677	165	721	145	765	180	809	155	853	175
678	175	722	160	766	165	810	150	854	170
679	160	723	165	767	175	811	145	855	160
680	155	724	165	768	150	812	160	856	190
681	135	725	155	769	180	813	165	857	180
682	175	726	160	770	160	814	150	858	130
683	140	727	155	771	160	815	175	859	155
684	150	728	160	772	160	816	150	860	185

Z. KUWANA

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
861	175	905	170	949	155	993	165	1037	155
862	160	906	160	950	150	994	175	1038	155
863	170	907	130	951	160	995	150	1039	175
864	160	908	155	952	180	996	140	1040	155
865	170	909	165	953	175	997	170	1041	145
866	170	910	135	954	145	998	175	1042	145
867	145	911	170	955	195	999	190	1043	140
868	140	912	170	956	130	1000	170	1044	155
869	160	913	145	957	200	1001	160	1045	165
870	170	914	155	958	210	1002	140	1046	160
871	175	915	155	959	165	1003	150	1047	160
872	165	916	185	960	130	1004	155	1048	130
873	160	917	145	961	150	1005	150	1049	150
874	185	918	150	962	170	1006	145	1050	140
875	140	919	160	963	165	1007	150	1051	145
876	140	920	160	964	170	1008	160	1052	165
877	155	921	160	965	140	1009	150	1053	145
878	165	922	135	966	165	1010	155	1054	140
879	140	923	170	967	160	1011	145	1055	190
880	165	924	170	968	185	1012	170	1056	150
881	180	925	145	969	175	1013	160	1057	160
882	160	926	150	970	155	1014	175	1058	135
883	145	927	190	971	160	1015	145	1059	185
884	160	928	155	972	160	1016	145	1060	155
885	200	929	160	973	160	1017	160	1061	170
886	160	930	160	974	135	1018	170	1062	205
887	170	931	190	975	145	1019	150	1063	145
888	175	932	155	976	190	1020	150	1064	150
889	135	933	140	977	175	1021	150	1065	200
890	155	934	185	978	140	1022	145	1066	155
891	165	935	155	979	160	1023	170	1067	135
892	155	936	160	980	155	1024	160	1068	160
893	170	937	200	981	165	1025	155	1069	180
894	160	938	160	982	155	1026	160	1070	130
895	175	939	160	983	160	1027	150	1071	150
886	170	940	140	984	145	1028	145	1072	160
897	175	941	135	985	140	1029	150	1073	170
898	160	942	155	986	170	1030	150	1074	165
899	160	943	180	987	150	1031	155	1075	150
900	150	944	145	988	185	1032	160	1076	190
901	140	945	150	989	170	1033	160	1077	170
902	150	946	140	990	150	1034	150	1078	180
903	155	947	180	991	150	1035	155	1079	135
904	150	948	170	992	155	1036	165	1080	140

No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
1081	165	1110	170	1139	145	1168	160	1197	135
1082	160	1111	170	1140	170	1169	185	1198	155
1083	160	1112	170	1141	165	1170	125	1199	165
1084	160	1113	160	1142	165	1171	155	1200	180
1085	155	1114	150	1143	150	1172	150	1201	150
1086	160	1115	145	1144	150	1173	155	1202	165
1087	150	1116	170	1145	185	1174	150	1203	155
1088	155	1117	150	1146	145	1175	170	1204	165
1089	145	1118	145	1147	120	1176	175	1205	165
1090	155	1119	155	1148	150	1177	170	1206	155
1091	130	1120	185	1149	165	1178	155	1207	160
1092	125	1121	165	1150	175	1179	180	1208	145
1093	150	1122	185	1151	175	1180	185	1209	150
1094	140	1123	155	1152	160	1181	150	1210	150
1095	180	1124	170	1153	170	1182	180	1211	165
1096	165	1125	155	1154	160	1183	150	1212	155
1097	160	1126	190	1155	155	1184	135	1213	140
1098	155	1127	160	1156	180	1185	140	1214	145
1099	155	1128	175	1157	140	1186	155	1215	155
1100	160	1129	185	1158	145	1187	155	1216	180
1101	135	1130	145	1159	195	1188	160	1217	165
1102	160	1131	145	1160	165	1189	200	1218	145
1103	150	1132	145	1161	160	1190	155	1219	165
1104	155	1133	170	1162	170	1191	150	1220	150
1105	150	1134	130	1163	140	1192	160	1221	150
1106	140	1135	170	1164	140	1193	145	1222	120
1107	165	1136	170	1165	145	1194	155		
1108	175	1137	170	1166	150	1195	160		
1109	155	1138	160	1167	145	1196	140		

Table 11

Change of body weight
The changes during the 4th sleep

Date No.	Oct. 30	Oct. 31	Novem. 1	(After ecdysis) Novem. 2
1	gm 0.6080	0.5936	0.5756	0.5312
2	0.5614	0.5480	0.5270	0.4906
3	0.6312	0.6154	0.6018	0.5544
4	0.6250	0.6112	0.5950	0.5362
5	0.6938	0.6800	0.6644	0.6326
6	0.6190	0.6030	0.5780	0.5448
7	0.5258	0.5124	0.4970	0.4726

8	0.5980	0.5800	0.5600	0.5322
9	0.6500	0.6292	0.6154	0.5838
10	0.6972	0.6834	0.6640	0.6338
11	0.6048	0.5912	0.5776	0.5490
12	0.6140	0.6008	0.5836	0.5560
13	0.5482	0.5348	0.5168	0.4898
14	0.5824	0.5690	0.5518	0.5228
15	0.7310	0.7174	0.7020	0.6678
16	0.5400	0.5246	0.5094	0.4766
17	0.5860	0.5724	0.5546	0.5072
18	0.5284	0.5126	0.4992	0.4570
19	0.5453	0 5312	0.5226	0.4918
20	0.6790	0.6632	0.6450	0.6054
21	0.5540	0.5406	0.5250	0.4886
22	0.6362	0.6212	0.6038	0.5678
23	0.6556	0.6380	0.6220	0.5736
24	0.5810	0.5664	0.5486	0.5150
25	0.5438	0.5316	0.5180	0.4910
26	0.6018	0.5856	0.5662	0.5482
27	0.6412	0.6228	0.6048	0.5692
28	0.5754	0.5638	0.5464	0.5194
29	0.6896	0.6700	0.6524	0.6106
30	0.6302	0.6166	0.5986	0.5588

The changes during the 5th larval stage

Date No.	May 14	May 15	May 17	May 18
1	0.4030	0.6138	1.1800	1.5752
2	0.4272	0.6462	1.3164	1.8202
3	0.4246	0.6164	1.3062	1.7582
4	0.4236	0.6182	1.2934	1.5944
5	0.4440	0.6594	1.3164	1.6770
6	0.4552	0.6790	1.4018	1.7678
7	0.4048	0.6222	1.2536	1.5820
8	0.4420	0.6310	1.2900	1.7554
9	0.4090	0.6294	1.3326	1.7068
10	0.4836	0.6964	1.4208	1.7160
11	0.4410	0.6590	1.3458	1.5130
12	0.4912	0.7226	1.4270	1.9144
13	0.4554	0.6676	1.3860	1.8020
14	0.4184	0.5942	1.2412	1.6044
15	0.4192	0.6434	1.2678	1.6118
16	0.4496	0.6466	1.3066	1.7220
17	0.4752	0.6732	1.2900	1.7746

18	0.4190	0.6484	1.3048	1.6688
19	0.3970	0.6042	1.2106	1.6446
20	0.4212	0.6062	1.3178	1.7240
21	0.4310	0.6132	1.2536	1.6410
22	0.4506	0.6602	1.3368	1.7784
23	0.4594	0.6728	1.3584	1.7470
24	0.4090	0.5988	1.2778	1.6460
25	0.3974	0.6240	1.2636	1.6222
26	0.4404	0.6578	1.4164	1.7388
27	0.4464	0.6616	1.3226	1.7248
28	0.4290	0.6206	1.3228	1.6716
29	0.4576	0.6414	1.3212	1.7336
30	0.3702	0.5422	1.0960	1.4074

The changes during the pupal stage

Date No.	May 22	May 23	May 25	May 26	May 29	May 30
1	0.9582	0.9412	0.9326	0.9232	0.9016	0.8868
2	1.0670	1.0350	1.0226	1.0138	0.9958	0.9832
3	1.0382	1.0128	1.0046	0.9966	0.9786	0.9654
4	0.9418	0.9274	0.9206	0.9126	0.8902	0.8758
5	1.0052	0.9844	0.9766	0.9676	0.9466	0.9327
6	1.1038	1.0800	1.0706	1.0618	1.0406	1.0244
7	0.9706	0.9580	0.9512	0.9434	0.9234	0.9100
8	1.0022	0.9864	0.9802	0.9724	0.9534	0.9374
9	0.9766	0.9574	0.9486	0.9380	0.9164	0.9026
10	1.0638	1.0502	1.0428	1.0344	1.0132	0.9982
11	0.9608	0.9478	0.9394	0.9306	0.9082	0.8930
12	1.0644	1.0460	1.0384	1.0294	1.0084	0.9930
13	1.0696	1.0444	1.0332	1.0226	0.9978	0.9818
14	0.9376	0.9230	0.9136	0.9038	0.8832	0.8706
15	0.9758	0.9624	0.9544	0.9464	0.9270	0.9124
16	0.9684	0.9560	0.9492	0.9414	0.9242	0.9118
17	1.1260	1.0990	1.0820	1.0676	1.0436	1.0290
18	0.9624	0.9472	0.9404	0.9322	0.9120	0.8970
19	0.9298	0.9102	0.9028	0.8958	0.8780	0.8666
20	1.0254	1.0006	0.9920	0.9836	0.9634	0.9490
21	0.9688	0.9528	0.9440	0.9344	0.9126	0.8978
22	1.0054	0.9898	0.9824	0.9742	0.9544	0.9418
23	1.0016	0.9860	0.9778	0.9676	0.9456	0.9310
24	0.9374	0.9222	0.9132	0.9036	0.8830	0.8690
25	0.9758	0.9602	0.9524	0.9426	0.9224	0.9092
26	1.0620	1.0442	1.0352	1.0252	1.0014	0.9850
27	1.0388	1.0196	1.0098	0.9988	0.9768	0.9620

28	1.0460	1.0272	1.0176	1.0048	0.9816	0.9678
29	0.9172	0.9082	0.9014	0.8934	0.8750	0.8630
30	0.9014	0.8892	0.8814	0.8724	0.8506	0.8370

17. Thirteen new Polyclads from Misaki

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(With 33 Text-figures and Plates XX–XXII)

This paper deals with thirteen new polyclads, listed below, which were found in the collection made in 1930–36 by Dr. M. Yeri in the vicinity of the Misaki Marine Biological Station. My hearty thanks are due to him for his kindness in having placed at my disposal the valuable material and life sketches of the worms.

ACOTYLEA

FAMILY STYLOCHIDAE

1. *Stylochus speciosus* sp. nov.
2. *Leptostylochus ovatus* sp. nov.
3. *Discostylochus yatsui* sp. nov.
4. *Cryptophallus eximius* sp. nov.

FAMILY CRYPTOCELIDAE

5. *Cryptocelis littoralis* sp. nov.

FAMILY LEPTOPLANIDAE

6. *Stylochoplana clara* sp. nov.

FAMILY PLANOCERIDAE

7. *Planocera profunda* sp. nov.
8. *Paraplanocera rubrifasciata* sp. nov.

COTYLEA

FAMILY PSEUDOCERIDAE

9. *Pseudoceros sagamianus* sp. nov.

FAMILY PROSTHIOSTOMIDAE

10. *Prosthiostomum auratum* sp. nov.
11. *Prosthiostomum ostreae* sp. nov.
12. *Prosthiostomum purum* sp. nov.
13. *Prosthiostomum yerii* sp. nov.

1. *Stylochus speciosus* sp. nov.

(Pl. XX, figs. 1, 2; Text-figs. 1–3)[1]

Five specimens of this species were found on oyster-shells cultivated in Moroiso Bay on Nov. 28, 1930.

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[1] Abbreviations in this and subsequent figures see p. 370.

In the living state the body is elongate oval in shape with somewhat frilled margin, measuring 32 mm long by 8 mm broad. The dorsal surface is of a greenish yellow color with a large number of dark spots. The ventral surface is paler and is devoid of spots.

Fig. 1. *Stylochus speciosus.* ×2.5.
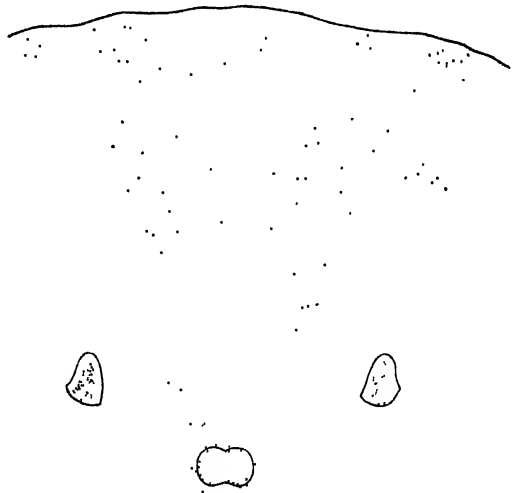
Fig. 2. *Stylochus speciosus;* arrangement of eye-spots. ×17.

The nuchal tentacles are slender and free from pigment, occurring near the hind end of the first sixth of the body. In the interior of the tentacles there are numerous eye-spots. The cerebral eyes are found on either side of the median line chiefly over the brain which lies a little behind the level of the tentacles. Along the margin of the anterior body-half there are densely arranged numerous eye-spots. The frontal eyes are few.

The general plan of the reproductive system is quite in accord with the type of the genus as shown in fig. 3. The seminal vesicle is a trilobed, anchor-shaped organ as in *Stylochus orientalis* (Bock, 1913), *ceylanicus* (Laidlaw, 1904), *ijimai* (Yeri and Kaburaki, 1918) and others. The prostate gland vesicle is of the *djiboutiensis*-type (Meixner, 1907) and almost as large as in *ijimai*, but much smaller than that of *aomori* (Kato, 1937 c). The extracapsular glands of the prostate are not only in the parenchyma around the vesicle but also in the ventral as well as dorsal parenchyma at a long distance from the vesicle and the secretion granules are carried by long efferent ducts to the prostate. Such an arrangement of the extracapsular gland is also noticed in both *ijimai* and *aomori*. The male and the female genital pore are closely applied, occurring in the middle between the last seventh and eighth of the body.

This species is distinguished from all other known ones of this genus, numbering about thirty, in the color-markings, the arrangement of eyes as well as in the larger size of the prostate vesicle in contrast to the thickness of the body.
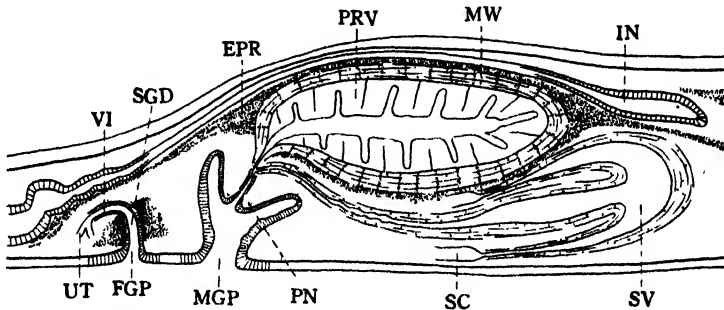
Fig. 3. *Stylochus speciosus;* longitudinal section through genital organs. ×70.

2. *Leptostylochus ovatus* sp. nov.
(Text-figs. 4, 5)

This new species is based on a single specimen obtained from the under-surface of stone between tidemarks at Araibama on Sept. 25, 1930.

In the preserved state the body is oval in shape, of a darkish brown color without any markings. It measures only 4.5 mm long by 3 mm broad at the widest part.

At the posterior limit of the second seventh of the body are found a pair of very small tentacles which are disposed about 0.3 mm apart. Only two tentacular eye-spots are present. A large number of cerebral eye-spots are scattered over the brain region in front of the level of the tentacles and indistinctly divided into two groups by the median line. Along the margin of the anterior third of the body are a certain number of marginal eye-spots.

The epidermis is much thicker on the dorsal than on the ventral side and contains a great many minute rhabdites and basophilous
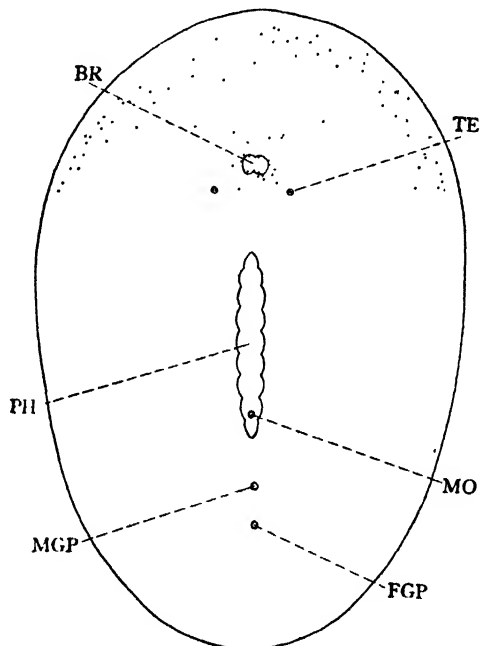
Fig. 4. *Leptostylochus ovatus* ×18.

secretion. The dermal musculature is poorly developed. The mouth occurs near the posterior end of the plicated pharynx which occupies almost the middle third of the body. The main intestine gives off about 7 pairs of lateral branches which repeatedly ramify toward the margin of the body and form deep pouches on the ventral side. In the intestine are found a mass of monocystid gregarines.

The seminal canal enlarges into a false seminal vesicle immediately behind the posterior end of the pharyngeal pocket. The false seminal vesicle is an ovoid muscular organ and its efferent duct runs posteromediad for a short distance and unites with that from the other side to form a median ejaculatory duct. The ejaculatory duct is very short, opening into the prostate gland vesicle at its ventral side. The prostate vesicle is lined with a folded epithelium and coated with a thick musculature. The prostate makes posteroventrally its way at the tip of a small conical penis by the narrow duct which is surrounded by the inner parenchymatous tissue and the outer thick muscular envelope. The antrum masculinum is very large and lined with strongly ciliated cells. The testes and ovaries are not yet fully developed.
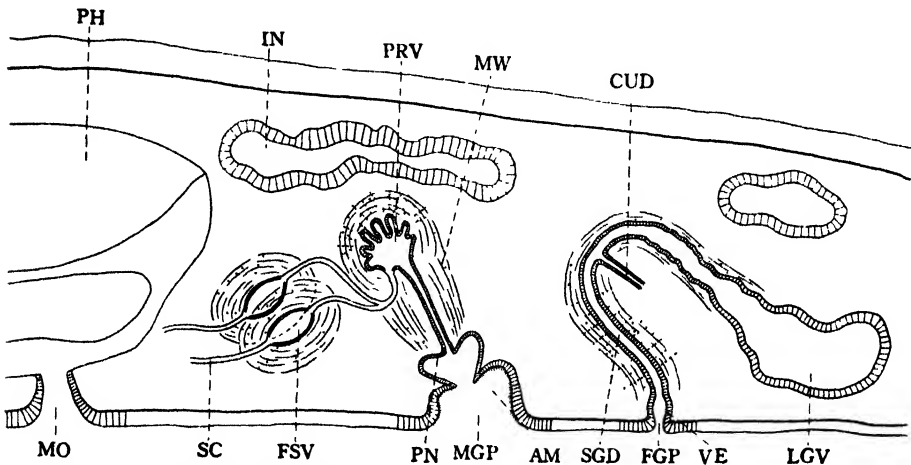
Fig. 5. *Leptostylochus ovatus;* longitudinal section through genital organs. ×150.

The narrow female genital pore lies immediately behind the male pore and lacks a sphincter around it. The vagina is provided with a thick muscular wall. The vagina externa is short and slightly enlarged, leading into the long shell gland duct. The vagina interna is also very short and after receiving from posteriad a common uterine duct continues to a moniliform duct of the Lang's glandular vesicle which is fairly large.

In the external appearance, this worm resembles well *Neostylochus fulvopunctatus* (Yeri and Kaburaki, 1920) but it belongs without doubt to *Leptostylochus* in the arrangement of eyes and the structure of genital organs. The shape of body is quite different from the slender form of *L. elongatus* (Bock,

1925 b) and *L. gracilis* (Kato, 1934 a).   Moreover, the direct connection of the ejaculatory duct with the prostate vesicle is a most remarkable feature of this species.   Besides the two species mentioned above, three other forms of *Leptostylochus* were recorded from Sydney (Bock, 1925 b), South Africa (Palombi, 1936) and Korea (Kato, 1937 b) respectively.

3.   *Discostylochus yatsui* sp. nov.
(Pl. XX, figs. 6, 7; Text-figs. 6–8)

The collection contains 'a single specimen of Stylochid which has the genito-intestinal canal.   Closer examination has revealed that this worm is referable to *Discostylochus* which is represented by a single species *parcus* (Bock, 1925 a) from Hawaii.   The present specimen was collected on the underside of stone in the tidal zone at Araibama on May 15, 1933.

In the living state the body is elongate oval in shape with slightly pointed anterior and posterior extremities and of a firm consistency.   It measures 40 mm in length and 15 mm in breadth.
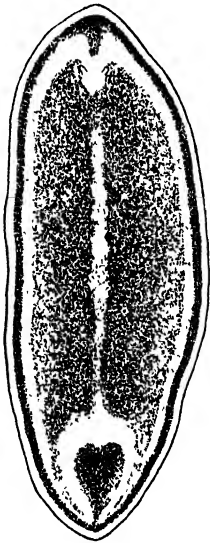
Fig. 6.   *Discostylochus yatsui.*   ×1.
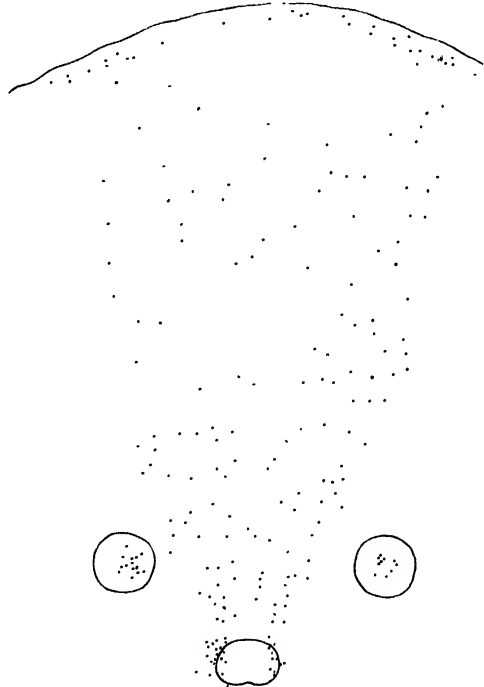
Fig. 7.   *Discostylochus yatsui ;* arrangement of eye-spots.   ×17.

The central parts of the dorsal surface ' are of a dark yellowish brown còlor which fades away toward the margin and is fainter along the median line. The extreme margin is totally colorless and the submarginal zone is dark yellowish-brown.   Cerebral region is colorless and a horse-shoe-shaped ; colorless

part occurs near the posterior end of the body. The ventral side is light brown.

A pair of small nuchal tentacles are situated at the hind limit of the first seventh of the body, at the base of each tentacle occur 30–40 eye-spots. The brain is situated slightly behind the level of the tentacles and on either side of it are scattered numerous cerebral eye-spots which are separated into two elongate clusters by the median line. A large number of eyes are disposed in the entire frontal part of the body and in addition numerous eyes are arranged along the margin in the anterior third of the body.

The epidermis is thicker on the dorsal side than on the ventral, composed of tall columnar cells and contains an abundance of minute eosinophilous secretion granules and a small number of rhabdites.

The musculature of the dorsal side consists of the outer longitudinal and the inner thick transverse layer. The ventral side is composed of the two longitudinal layers and the developed circular layer between them.

The mouth is situated at the posterior limit of the second third of the body close to the posterior end of the pharyngeal pocket. The pharynx is about two-thirds the body-length and moderately plicated with many deep side-chambers.
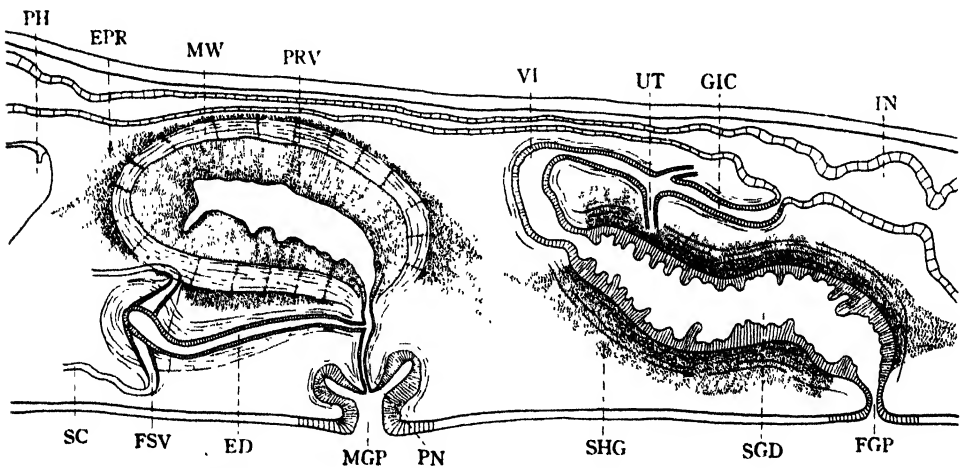
Fig. 8. *Discostylochus yatsui*; longitudinal section through genital organs. ×70.

Running on either side of the body the seminal canals, full of spermatozoa, turn mediad a little behind the posterior end of the pharyngeal pocket and gradually increase its diameter as well as the thickness of the muscular wall and finally unite to form an ejaculatory duct in the median line behind the posterior end of the prostate vesicle. In *parcus* the seminal canal enlarges into a distinct pear-shaped false seminal vesicle which sends out medially a short, muscular efferent duct which forms an ejaculatory duct with that from the other side. In the present species the false seminal vesicle is directly connected with the median ejaculatory duct and resembles the anchor-shaped seminal

vesicle of *Stylochus*. The ejaculatory duct is very large with thick muscular walls and opens posteriorly into the duct from the prostate vesicle. The prostate vesicle is a large ovoid structure with thick muscular walls, through which open numerous efferent ducts of the extracapsular prostate glands. The extracapsular glands are embedded in the dorsal and the ventral parenchyma far from the vesicle as in *Stylochus speciosus*. The duct of the prostate runs down vertically and after receiving the ejaculatory duct makes its way at the tip of the bluntly conical penis.

Situated a little behind the male genital opening, the female gonopore passes anterodorsally into a long and wide shell gland duct through the short vagina externa. The shell gland duct is lined with much folded epithelium and on its entire course receives an abundance of shell secretion. Bending backward on the dorsal side the vagina interna receives a pair of uteri on either side and runs further posteriad to open as the genito-intestinal canal to the median intestinal branch. In *parcus* the common uterine duct is formed by the union of two uteri, but in this species it does not. Bock (1925 a, p. 41) states that "first of all, one would expect that, when Lang's glandular vesicle is present, the vagina would receive one unpaired median uterine duct instead of both uteri directly". But this does not hold in all polyclads, since *e. g. Paraplanocera* (Kato, 1936 b) has no common uterine duct.

I take pleasure in naming this species in honor of Professor N. Yatsu.

4. *Cryptophallus eximius* sp. nov.
(Pl. XX, figs. 3–5; Text-figs. 9–11)

A single specimen of this interesting polyclad provided with the genito-vaginal canal was collected under the stone near the low tidemark at Bentensita on July 26, 1930.

The body is elongate oval, very firm in consistency, 70 mm long by 30 mm broad in the expanded state. The dorsal surface is uniformly grayish brown and the ventral paler.

The measurements of the preserved specimen are as follows: The length of the body is 50 mm and the width 32 mm. The tentacular eyes from the anterior end are 9 mm and 1.8 mm apart. The mouth opening from the anterior end is 19 mm. The male genital pore from the posterior end is 10 mm and the female opening is 4 mm posterior to the male pore. The specimen was preserved in a nicely expanded condition (Pl. XX, fig. 3). The same condition was observed in the specimens of *Cryptophallus wahlbergi* (Bock, 1913) and *C. sondaicus* (Bock, 1925 b).

The tentacles are the slight elevations of epidermis. Each group of the tentacular eyes consists of about 13 ocelli. A large number of eyes are arranged in a single cluster as shown in fig. 9. Frontal eyes are not so many. Marginal eyes are found around the entire body, irregularly arranged in many rows. The ocelli are sparsely pigmented.

The epidermis is a little higher on the dorsal than on the ventral side.

It contains much eosinophilous secretion granules and a small quantity of shapeless cyanophilous secretion. The dermal musculature is powerful on the dorsal side than on the ventral and is composed of fairly complex circular and longitudinal muscle layers.

The mouth opening lies at the hind level of the second fifth of the body, and slightly behind the hind limit of the first fifth of the pharynx which is 28 mm long. The pharynx is plicated, provided with about 20 pairs of side-chambers.

The male genital pore lies directly beneath the posterior end of the pharynx, at about the anterior limit of the last fifth of the body. The seminal canals turn mediad at this level and enlarges into the elongate tubular false seminal vesicles as in *C. wahlbergi* and *sondaicus*. The seminal vesicles taper medio-dorsally and join into a single duct, the ejaculatory duct which proceeds ventrad to open at the tip of the penis. The penis is muscular, of a flat conical shape and is disposed vertically in the penis sheath. The prostate vesicle is very small and vertically placed over the penis opening near the apex of the penis together with the ejaculatory duct.

Fig. 9. *Cryptophallus eximius;* cerebral and tentacular eye-spots. ×28.

Fig. 10. *Cryptophallus eximius;* marginal eye-spots. ×70.

Occurring far posterior to the male gonopore, the female pore passes to the narrow vagina externa which continues anteriorly to the long shell gland duct. The short posterior part of the shell gland duct is extremely narrow and continues to the long broad middle portion which again tapers upwardly. This last portion of the duct is lined with much folded epithelium as in *sondaicus*. The shell glands open in *sondaicus* into this portion of the vagina, but in the present form they empty into the whole length of the shell gland duct as in *C. bartschi* (Kaburaki, 1923). On the dorsal side of the body the vagina interna receives ventrally two uteri, and takes a posteroventral

course as the genito-vaginal canal to open into the vagina externa near the genital pore. The uteri are distended with a large quantity of ova.

Under the genus *Cryptophallus* have been recorded three species, *wahlbergi* from Port Natal, *sondaicus* from Amboina and *bartschi* from Tominado Island.
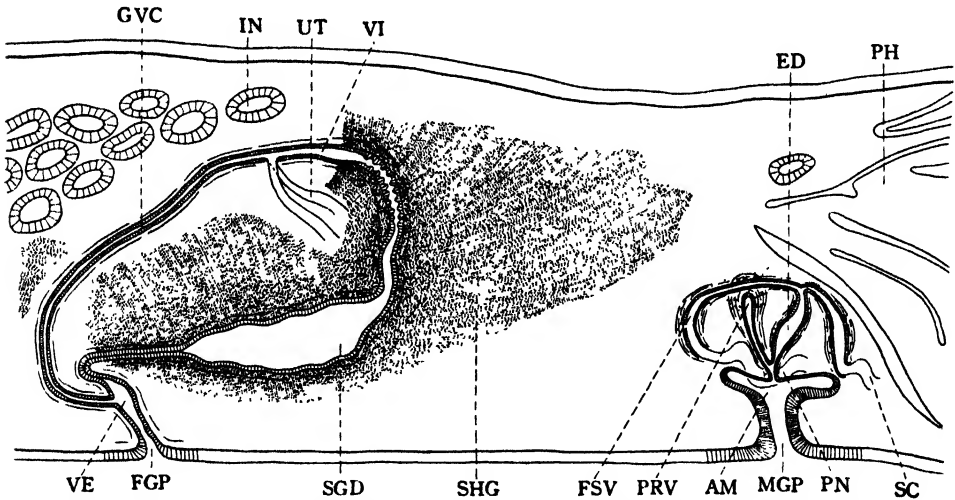
Fig. 11. *Cryptophallus eximius;* longitudinal section through genital organs. ×35.

The present species somewhat resembles *wahlbergi* but is distinguished from it in various minute points described above. Freeman (1933) described *Cryptophallus magnus* from the neighborhood of Puget Sound, North America. However, judging from the description and figures, this seems to be identical with Bock's *Kaburakia excelsa* from False Narrows, Nanaimo, Vancouver and Puget Sound (Bock, 1925 b, p. 142).

5. *Cryptocelis littoralis* sp. nov.

(Pl. XX, figs. 8, 9; Text-figs. 12-14)

This new species is based on two specimens collected under the stone at Aburatubo on May 28 ·and July 15, 1930.

The body in life is firm and thick, of an oval shape, slightly broader anteriorly. Both the anterior and posterior ends are terminated bluntly. It measures 50 mm in length and 35 mm across the broadest part of the body. The color of the body in alcohol is uniformly brown.

There is no tentacle. A couple of tentacular groups of eyes, 10–15 in number, are located at the hind end of the first ninth of the body, about 1.5 mm apart. Slightly in front of the level of the tentacular groups of eyes is situated the brain, over which are arranged two elongate clusters of numerous eye-spots. The cerebral eyes are deeply embedded in the parenchyma but the tentacular ones lie rather superficially. Marginal eye-spots are arranged in

rows along the whole dorsal margin, being distributed more densely at the anterior end.

Fig. 12. *Cryptocelis littoralis*; cerebral and tentacular eye-spots. ×35.

Fig. 13. *Cryptocelis littoralis*; marginal eye-spots. ×35.

The epidermis is rather thick, containing an abundance of eosinophilous secretion granules and spindle-shaped rhabdites. The musculature is well developed as in *Cryptocelis amakusaensis* (Kato, 1936 a).

The mouth lies near the center of the body and leads into the pharyngeal pocket containing the plicated pharynx of about one-third the length of the body.

Taking a tortuous course the seminal canal enormously enlarges near the posterior end of the pharyngeal pocket and abruptly tapers to run posteriad for a short distance. Here the canal pierces mediodorsally the thick muscular envelope of the prostate vesicle to open into it. The prostate vesicle is composed of two parts. The proximal part is a large slightly tortured ovoid body as in *ijimai* (Bock, 1923 a) and the distal part is a duct with numerous deep folds as in *alba* (Lang, 1884) and *amakusaensis*. In
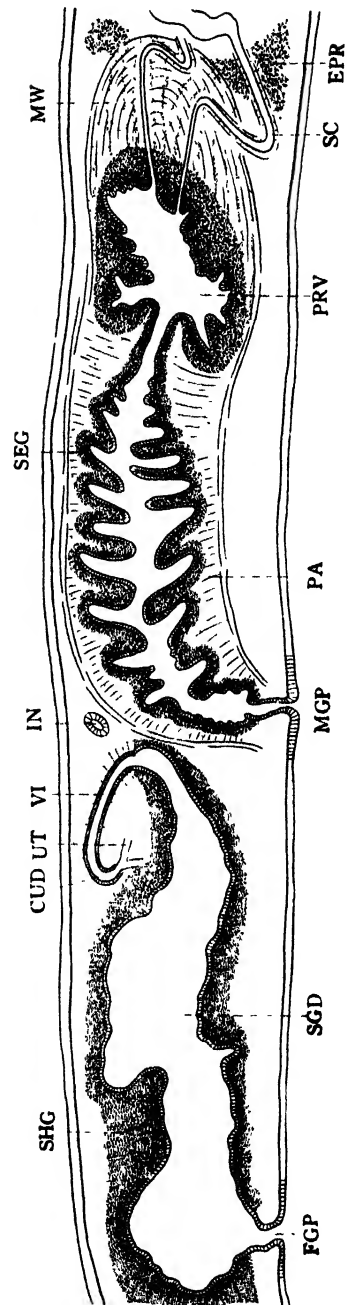
Fig. 14. *Cryptocelis littoralis*; longitudinal section through genital organs. ×22.

compacta (Lang, 1884) and *ijimai* this duct takes a spiral course and in *glandulata* (Jacubowa, 1909) it is provided with the special glandular vesicle.

The proximal part is lined with ciliated cuboidal epithelium and around it is an accumulation of eosinophilous secretion granules which are carried through the thick muscular wall by narrow ductules from the glands. They are densely grouped in the parenchyma directly behind the prostate. The distal part is lined with cuboidal cells and provided with an outer thick layer of the sub-epithelial gland cells. The prostate gradually tapers posteroventrally to open to the exterior by a narrow pore at about the level of the anterior margin of the last fourth of the body.

The female genital pore is widely separated from the male. The general plan of the female organs are quite in accord with those of other species of this genus. The shell gland duct extends as far as the wall of the prostate as in *amakusaensis* and passes dorsoposteriorly into the narrow vagina interna. Into the portion of the vagina are discharged fine secretion granules quite different from the shell gland secretion of a spindle shape. The vagina interna runs for a short distance and ventrally continues to the common uterine duct which eventually bifurcates into two uteri.

Under the genus *Cryptocelis* have been recorded three European and two Japanese species mentioned above. The planarian resembles *ijimai* obtained by Bock at Misaki from a depth of about 10 m, but is distinguished from it in the structure of the prostate vesicle and the total absence of the postgenital vesicle behind the female gonopore.

6. *Stylochoplana clara* sp. nov.
(Pl. XXI, fig. 5; Text-figs. 15, 16)

This species is commonly found living on *Zostera* and *Phyllospadix* all the year round.

In the living state the body is thin, flat, broad and rounded in front, tapering toward the posterior end which is slightly pointed. The large specimen is 5 mm long and 2 mm across the broadest anterior part of the body. The body is pellucid light green, slightly darker along the median line and the intestinal and the genital system are well discernible from outside.

At the hind margin of the second ninth of the body lie the brain and a pair of slender nuchal tentacles. At the base of the tentacles occur two or three eye-spots and on either side of the brain are found several cerebral eye-spots.

The mouth is located at the center of the body and at the hind end of the pharynx. The pharynx is poorly plicated, lacking distinct side-pockets and opens at its anterior end into the main intestine. Numerous cyanophilous glands open to the anterior wall of the mouth.

The epidermis consists of rather flat, cuboidal cells, containing a large nucleus and rod-shaped rhabdites. In spite of the thinness of the body the dermal musculature is well developed. The dorsal side is composed of the

outer circular, the middle longitudinal and the inner circular layer; the ventral side of the outer longitudinal and the inner circular, and between them run two diagonal muscle layers whose fibers intersect at right angles. The dorso-ventral muscle bundles are well developed.

The seminal canals proceed backward along either side of the body and turn mediad slightly behind the end of the pharyngeal pocket to unite into a single duct which immediately passes into the seminal vesicle at its posteroventral aspect. The vesicle is tubular with a rather thick muscular wall. It curves upwardly to send off a narrow duct which piercing horizontally the strongly developed muscular envelope opens into the dorsal side of the prostate vesicle. This subcentral opening of the seminal vesicle to the prostate is an exceptional case in *Stylochoplana*. The prostate is a large elongate ovoid body lined with tall columnar cells and receives numerous efferent ducts of the extracapsular gland through its muscular wall. The vesicle tapers posteriorly to open at the apex of the penis. The penis is a large conical, muscular process with a slightly curved, pointed apex and is covered with a thick membrane similar to the basement membrane of the body wall. The penis is horizontally disposed in the specially differentiated penis sheath. The sheath is wide,

Fig. 15. *Stylochoplana clara.* ×24.
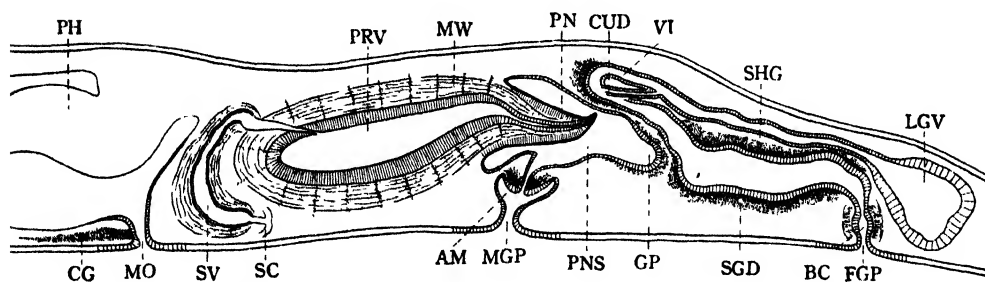
Fig. 16. *Stylochoplana clara;* longitudinal section through genital organs. ×95.

provided at its hind end a deep glandular pouch lined with tall cells, into which is discharged the eosinophilous secretion carried from the glands scattered in the parenchyma around this pouch. Ventrally the penis sheath opens to the antrum masculinum with the muscular hemispherical process, the epithelium

of which is glandular and taller than that of other parts. The male genital pore is situated at the hind margin of the second third of the body.

The female genital pore lies widely separated from the male, slightly in front of the middle between the male gonopore and the posterior end of the body. The vagina externa is surrounded with a strong muscular wall to form a bursa copulatrix. It passes into the wide shell gland duct which extends over the penis sheath and abruptly turns posteriad to lead to the vagina interna. The latter eventually receives a rather long common uterine duct and continues to the duct of the Lang's glandular vesicle. This vesicle is moderately large, located directly behind the female genital aperture. The shell gland secretion is of a spindle shape. The present planarian is entirely different from *Stylochoplana viridis* (Freeman, 1933) found on the eel grass near Puget Sound and all other species of this genus in the structure of the penis and its sheath and also in the possession of bursa copulatrix.

7. *Planocera profunda* sp. nov.

(Pl. XXI, figs. 6, 7; Text-figs. 17, 18)

Numerous specimens of this species were collected on Jan. 10, 1935 by the dredge from the depth of 18–20 fathoms off Moroiso.

The body in the preserved state is thin and oval, measuring 16 mm by 7 mm. The ground color of the body is light yellow and the dorsal surface is ornamented with dark spots and the reticulation of reddish brown minute pigment.

Slightly in front of the first third of the body lie a pair of long conical nuchal tentacles which are much pigmented. The arrangement of the eyes is similar to that of other *Planocera* as shown is fig. 17.

The mouth is near the center of the body and leads into the pharyngeal pocket containing the plicated pharynx. The main intestinal branches are in about 5 pairs.

The dorsal musculature consists of the outer thick longitudinal and the inner circular layer while on the ventral side are found the outer longitudinal, the middle diagonal and the inner longitudinal layer.

Numerous testes are in the ventral part. Situated slightly behind the

Fig. 17. *Planocera profunda*; eye-spots. ×22.

posterior end of the second third of the body, the male genital pore continues anteriorly to the wide cirrus cavity lined with tall ciliated columnar cells, showing transitional stages to chitinous bristles commonly found on the lining of the cirrus in Planocerid-polyclads. The cirrus cavity continues anteriad to a wide duct from the prostate vesicle. Surrounding this duct is a mass of

reticulated muscle fibers. The prostate vesicle is spherical, lined with much folded epithelium and coated with the muscular wall which are perforated by numerous efferent ducts of extracapsular gland. The tubular seminal vesicle receives from anteriad two seminal canals and posteriorly tapers into the ejaculatory duct which lies directly beneath the prostate, curving upward and opening into the duct from the prostate. The cirrus bulb together with the prostate vesicle are covered with a thick musculature.

The female genital pore lies widely separated from the male. It directly leads into the wide elongate vagina bulbosa with a thick muscular wall. The vagina continues anteriorly to the shell gland duct which turns abruptly backward at the level of the male genital aperture to pass to the short vagina interna. The common uterine duct is very short, opening into the vagina near its turning point. The Lang's glandular vesicle is very small and ovoid lying immediately behind the level of the female genital pore. Shell gland secretion is not yet formed and the ovaries are not fully developed.

Under the genus *Planocera* have been recorded about fifteen species from various localities of the world. This species is distinguished from all the others heretofore described in the color-patterns of the dorsal surface and in the structure of the genital organs.

Fig. 18. *Planocera profunda*; longitudinal section through genital organs. ×35.

8. *Paraplanocera rubrifasciata* sp. nov.

(Pl. XXI, figs. 1-4; Text-figs. 19, 20)

This new species is based on a single specimen dredged on Sept. 9, 1932 from a depth of 15 fathoms off Hutamatiya.

In the preserved state the body is oval in shape with a slightly frilled margin and the anterior end a little broader than the posterior. It measures 15 mm long by 11 mm broad.

The ground color of the dorsal surface in alcohol is whitish yellow and spotted with brownish purple minute granules more densely distributed in the central part. Along the entire margin occurs a red band which is broken at

many places. The red pigment is well preserved in the preparation, having withstood of various treatments received during the processes.

The nuchal tentacles are situated at the hind end of the first fourth of the body. The arrangement of eyes is shown in fig. 19.

The mouth lies near the center of the body. The genital apertures are closely disposed at about the anterior end of the last fourth of the body.

The internal organization of this species is almost in

Fig. 19. *Paraplanocera rubrifasciata;* eye-spots. ×55.

accord with that of *Paraplanocera misakiensis* (Kato, 1936 b). As to the coloration this species somewhat resembles *P. aurora*, but in the latter species the whole dorsal surface of the body is red as shown in the figure of Laidlaw (1903 c, Pl. 9, fig. 1). The paramarginal glands are also present as in *misakiensis*.
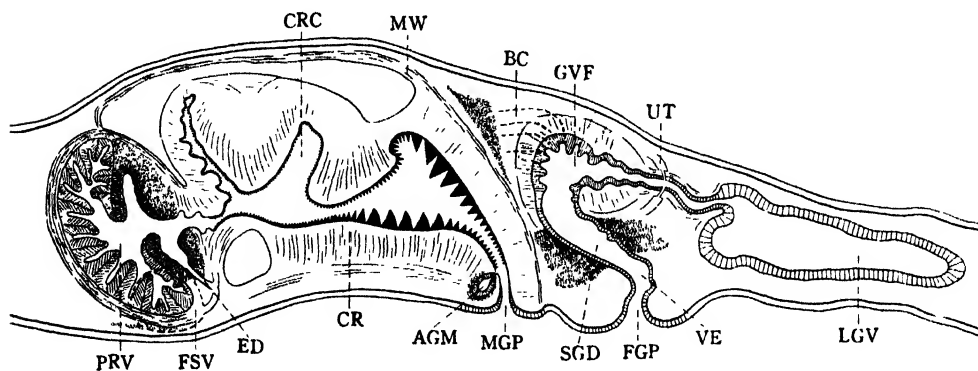
Fig. 20. *Paraplanocera rubrifasciata;* longitudinal section through genital organs. ×35.

A pair of glands accessory to the male antrum exist as in *discus* (Jacubowa, 1906), *marginata* (Meyer, 1922) and *misakiensis*. The ventral wall of the cirrus is rather smooth but its dorsal wall is irregularly folded to form a few large processes. The cirrus is devoid of chitinous folds and the inner surface of its cavity is beset with chitinous spines, those at the anterior part being very strong. The prostate vesicle is a large bun-shaped body with a rather thick muscular wall, consisting of two parts as in *misakiensis*. The anterior part is pileus shape, lined with a folded epithelium and contains a small quantity of eosinophilous secretion; the posterior part is rather small, containing much

secretion.   In the ventral part of the hind prostate opens the median ejaculatory duct which is formed by the union of two efferent ducts issuing from the false seminal vesicle on either side of the body.   The structure of the bursa copulatrix and the seminal receptacle are very similar to those of *misakiensis*, but the glandular vesicle is much larger in this planarian.   The uteri open separately into the vagina, abruptly tapering at the point of entrance.

9.   *Pseudoceros sagamianus* sp. nov.

(Pl. XXII, figs. 9-11; Text-figs. 21, 22)

A single specimen of this *Pseudoceros* was collected on April 6, 1935 at Bentensita.

In the preserved state the body is elongate oval with somewhat frilled margin, 17 mm long by 12 mm broad.   The color of the dorsal surface is brown, darker along the median line.   Numerous white maculae of various sizes and shapes are found on the dorsal surface.   The entire body margin is bordered with a narrow black band.   The ventral surface is uniformly light brown.
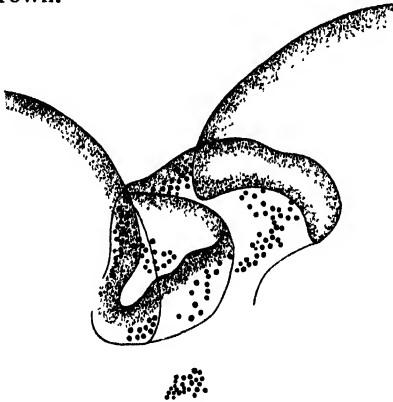
Fig. 21.   *Pseudoceros sagamianus*; marginal tentacles and eye-spots.   ×70.

The marginal tentacles appear as two short folds of the frontal margin of the body and are provided with a large number of eye-spots.   The cerebral eye-spots, about 25 in number, form a single cluster near the base of the tentacular folds.   The epidermis is thicker on the dorsal side than on the ventral and contains spindle-shaped rhabdites and fine secretion granules faintly stained with eosin.   The dorsal epidermal cells contain a large amount of minute rod-shaped pigment granules in their proximal part.

A sucker lies at the center of the body.   The mouth is situated closely behind the cluster of cerebral eye-spots. The pharynx is plicated and the intestinal branches form an anastomosing system.

The testes lie in the ventral half of the body.   Proceeding forward the seminal canals turn medially near the level of the female genital pore and open separately into a large seminal vesicle of an ellipsoidal shape and with a moderately thick musculature.   Issuing from the anteroventral part of the vesicle, the narrow ejaculatory duct takes a tortuous forward course to merge into the penis.   Here it joins with the duct from the prostate vesicle.   The prostate is rather small and lies horizontally over the base of the penis.   It is of an elongate ovoid shape and is lined with strongly columnar cells and is provided with a muscular wall, through which pierce the ducts of the extra-

capsular gland. The elongate conical penis has a sharply pointed stylet and is disposed vertically in the penis sheath. The antrum masculinum is wide and deep, opening to the exterior by a narrow pore slightly in front of the middle between the anterior end of the body and the sucker.
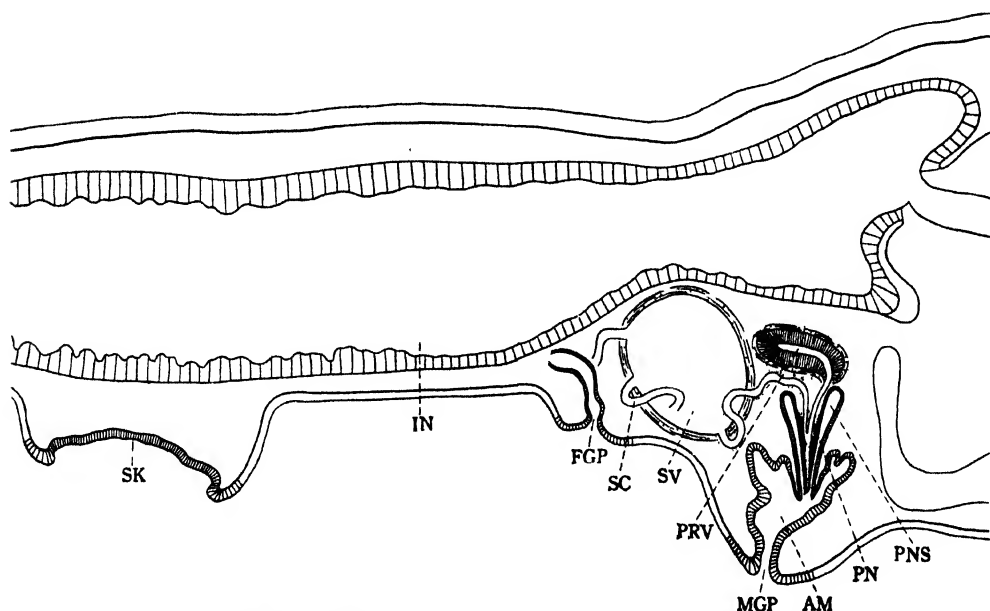
Fig. 22. *Pseudoceros sagamianus;* longitudinal section through genital organs. ×35.

The female genital aperture is a little behind the male pore. The female genital organs are in the same plan as in other species of this genus. The testes are in a fully developed state and the seminal canals and vesicle are full of sperm. The ovaries, however, are not yet developed and the shell gland secretion are not found.

Of about twenty species of *Pseudoceros* this worm resembles *P. nigromarginatus* (Yeri and Kaburaki, 1918) in the possession of the black margin, but is distinguished from it in the maculated dorsal color-markings.

10. *Prosthiostomum auratum* sp. nov.
(Pl. XXII, fig. 8; Text-figs. 23, 24)

This is one of the four new species of *Prosthiostomum*. This worm was found on Aug. 28, 1936 creeping on *Phyllospadix*.

The body in life is slender, anteriorly rounded and posteriorly tapering to a point and of a firm consistency, measuring 8 mm long by 1 mm broad. The color of the body is uniformly golden yellow without any markings whatever and is a little fainter along the median line. The ovaries appear as whitish spots.

At the distance of 0.5 mm from the anterior extremity lies the brain, on either side of which are cerebral eyes in two linear groups of 7 ocelli each. The marginal eyes about 12 in number are arranged in a single row along the frontal margin. The mouth is located immediately behind the brain. The pharynx is long cylindrical. The anterior median branch of the intestine runs for a short distance to end blindly. The ventral musculature is strongly developed compared with that of the dorsal and owing to this structure the animal is considerably warped at the time of fixation. A large sucker is situated slightly behind the middle of the body.
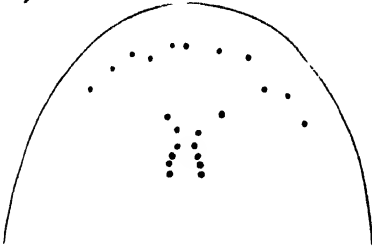
Fig. 23. *Prosthiostomum auratum;* eye-spots. ×35.
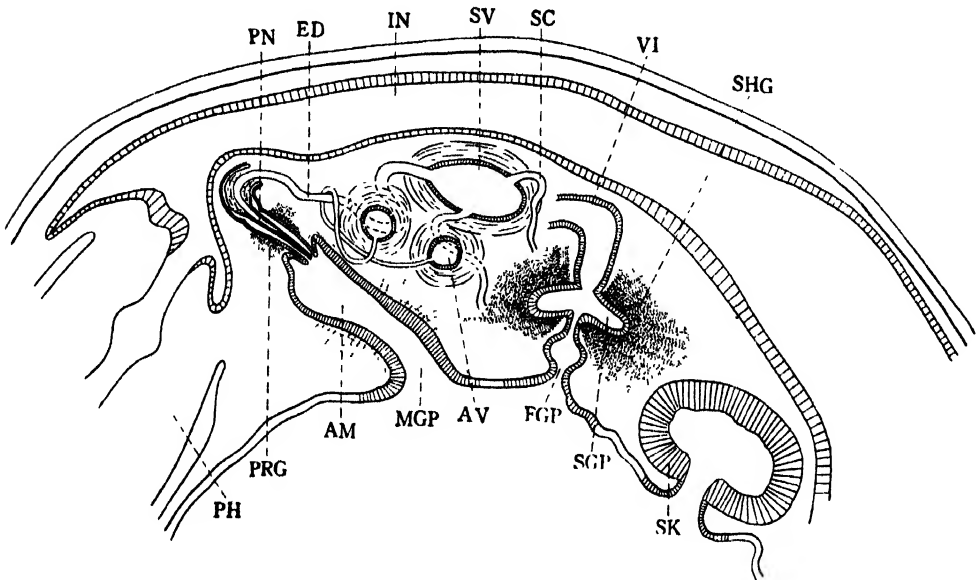
Fig. 24. *Prosthiostomum auratum;* longitudinal section through genital organs. ×120.

The arrangement of the genital organs is closely similar to that found in other species of this genus as shown in fig. 24. The seminal canals open into the large seminal vesicle at the posterolateral respects. The ejaculatory duct is very long, receiving in the midway a pair of ducts from the accessory vesicles which are moderately large. The penis is provided with a sharply pointed slender stylet at its apex. Surrounding the antrum masculinum are scattered numerous unicellular glands which discharge the secretion into the antrum.

11. *Prosthiostomum ostreae* sp. nov.

(Pl. XXII, figs. 4, 5; Text-figs. 25-27)

This new species is based on three specimens found on Nov. 29, 1932 on cultivated oyster-shells at Moroiso.

The body is very elongate with a broadly rounded anterior end and a pointed posterior extremity. The large specimen measures 26 mm by 2 mm. The dorsal surface is light brown with a median brown band and maculated evenly with reddish brown. Some white specks occur in the brown band. The margin is partly of a lemon yellow color. The cerebral region is colorless.

The cerebral eyes are divided into two groups by the median line and each consists of 20–25 ocelli. Marginal eyes numbering 80–90 are irregularly scattered along the anterior margin. The mouth lies immediately behind the brain and leads into a cylindrical pharynx. A large sucker occurs at about the middle of the body. The median anterior branch of the intestine is short.

The genital apertures lie closely behind the pharyngeal sheath. The seminal canals, proceeding from behind, abruptly turn mediad immediatly behind the penis to enter the anteroventral end of the large ovoid seminal vesicle, which is provided with a thick muscular wall, and gives rise anteriorly to the ejaculatory duct. After receiving the ducts from two small spherical accessory vesicles, the ejaculatory duct merges into the base of the penis and opens to the exterior at the tip of the pointed stylet. The stylet is rather thick and abruptly tapers from the middle of its length. The penis sheath is a little constricted at the middle and in its lower half open the prostate glands. Into the antrum are discharged much secretion from the glands scattered in the surrounding parenchyma.

Fig. 25. *Prosthiostomum ostreae.* ×4.

Half way between the male genital pore and the sucker occurs the female aperture which upwardly passes into an expanded shell gland pouch. The vagina interna turns anteriad to receive the uteri. While the seminal canals and vesicle are full of sperm, the female reproductive organs are still in a rudimental condition.
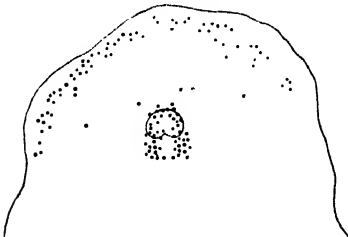
Fig. 26. *Prosthiostomum ostreae;* arrangement of eye-spots. ×18.
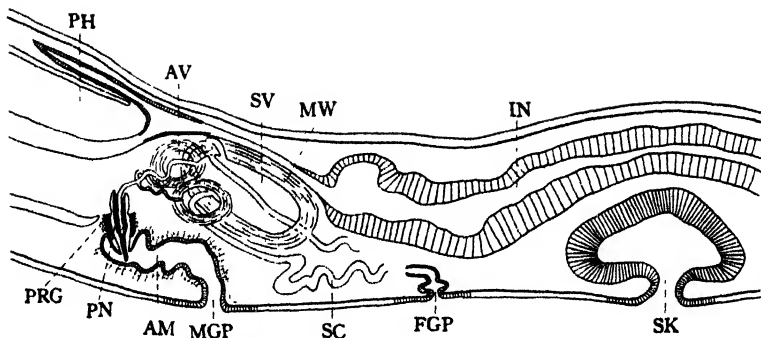
Fig. 27. *Prosthiostomum ostreae;* Longitudinal section through genital organs. ×55.

12. *Prosthiostomum purum* sp. nov.

(Pl. XXII, figs. 6, 7; Text-figs. 28–30)

Six specimens of this species were collected in the autumn of 1932 from a depth of 15 fathoms off Hutamatiya.   Another specimen was obtained on Sept. 16, 1936 at Susaki, Idu.

Fig. 129. *Prosthiostomum purum;*
arrangement of eye-spots. ×35.

Fig. 28. *Prosthiostomum purum.* ×5.

The body in life is very elongate and of a delicate consistency, measuring 15–20 mm long by about 1 mm broad.   The anterior end is rounded and the posterior tapers to a point. The body is translucent milky white without any color-patterns.   The arrangement of eyes is shown in fig. 29, the cerebral eyes are few and the marginal fairly numerous.

The mouth lies immediately behind the brain and leads into the pharyngeal chamber which contains a cylindrical pharynx.   The pharynx is very short in contrast to the body-length, occupying one-fifth or one-sixth the body-length.   The anterior median branch of the intestine is short.   A small sucker is located at about the center of the body.

In other species of *Prosthiostomum* the copulatory organs occur usually immediately behind the posterior end of pharynx.   In the present species they are widely separated from it owing to the shortness of the pharynx. The general plan of the genital system is in accord

with the type of the genus. In the immature specimens the accessory vesicles are distinctly separated from each other, but in a mature one collected at
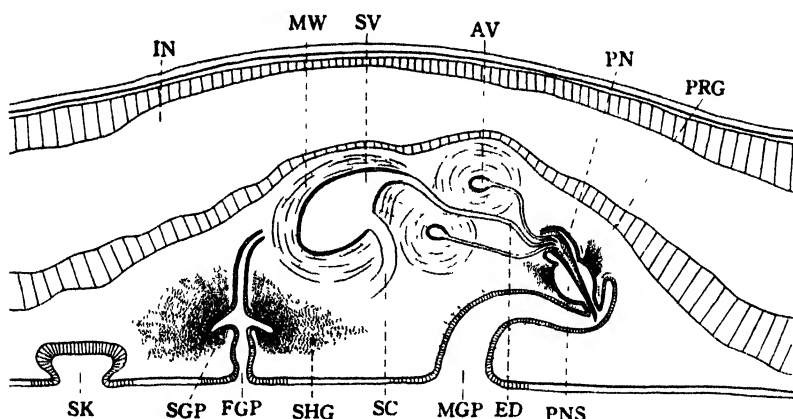
Fig. 30. *Prosthiostomum purum;* longitudinal section through genital organs. ×85.

Susaki they are found to be so closely approximated that a part of muscle fibers of each vesicle wall overlap. Such a feature reminds us of the same structure of *Enchiridium periommatum* (Bock, 1913).

13. *Prosthiostomum yerii* sp. nov.
(Pl. XXII, figs. 1-3; Text-figs. 31-33)

One specimen of this species was obtained on Sept. 7, 1932 from a depth of 15 fathoms off Hutamatiya. Four specimens were collected in the autumn of 1936 at Susaki.

The body is broad with the rounded anterior and pointed posterior ends. It is of firm consistency. The large specimen measures 25 mm long by 4 mm broad.

The dorsal surface is generally of a milky white with a faint touch of brown, having a longitudinal reddish brown band running from behind the cerebral eyes to the posterior end of the body. In one specimen this band is bordered with a dark stripe. Over the cerebral region is a patch of the reddish brown color, which gives off a median and two anterolateral processes. The region over the cerebral eyes is colorless. The cerebral eyes are fairly abundant and indistinctly divided into two lateral clusters which converge anteriorly. The marginal eyes are also numerous, distributed along the anterior end of the body as is shown in fig. 32.

The epidermis is higher dorsally than ventrally, containing an abundance of slender rhabdites. The mouth lies immediately behind the brain and leads into the cylindrical pharynx. The pharynx is rather thin, inasmuch as the anterior median branch of the intestine runs over the pharynx to the cerebral region. A large sucker is situated slightly behind the center of the body.

The male genital pore lies immediately behind the end of the pharyngeal pocket and leads upwardly into a wide antrum which passes into the penis sheath. Into the constricted ventral half of the sheath are discharged prostatic secretion granules. The penis is a cylindrical muscular structure provided with a stylet at the tip. At the base of the penis the ejaculatory duct receives two short ducts of the accessory vesicles. The accessory vesicle is moderately large, of a pyriform shape and its efferent duct is coated with the musculature derived from the surrounding musculature of the vesicle itself. Situated behind the accessory vesicles, the seminal vesicle is rather small, ovoidal, provided with a thin muscular walls and receives at the posterolateral respects a pair of the seminal canals.

The female genital aperture lies a little anterior to

Fig. 31. *Prosthiostomum yerii.* ×4.
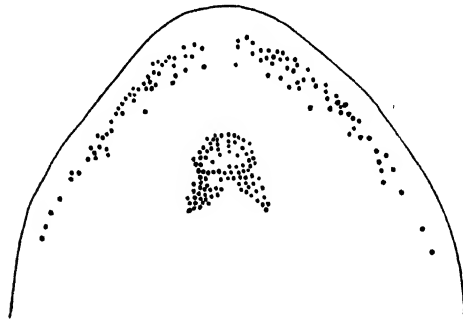
Fig. 32. *Prosthiostomum yerii;* arrangement of eye-spots. ×17.
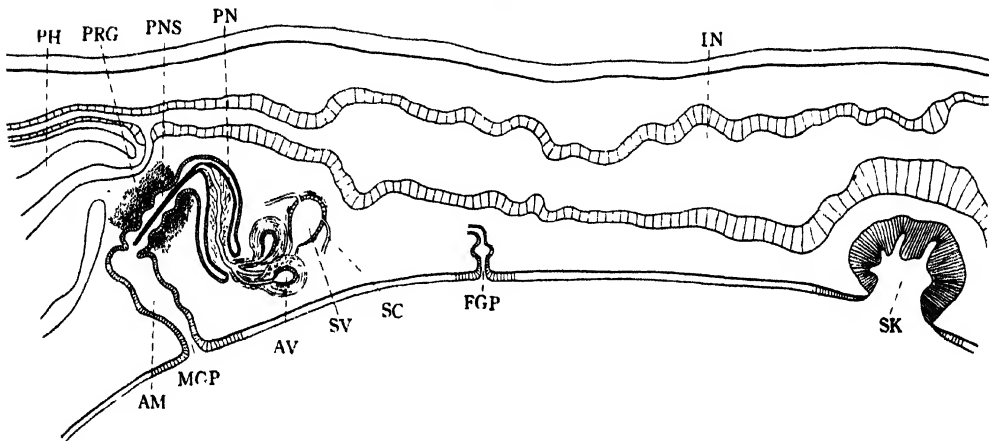
Fig. 33. *Prosthiostomum yerii;* longitudinal section through genital organs. ×70.

the half way between the male pore and the sucker. The female genital organs are not fully developed but the shell gland pouch and the anteriorly directed vagina interna are observed.

In 1925 Bock erected the genus *Euprosthiostomum* for *E. adhaerens* living associated with hermit crabs in Panama and the following diagnosis was given: " 1) Prosthistomids with marginal eyes only in the anterior region of the body and frontal eyes. 2) No gut branch above the pharyngeal pocket; 3) The two separate accessory vesicles of the male apparatus small, club-shaped, with short efferent ducts forming the direct continuation of the vesicle; 4) The proximal part of the vagina directed forwards; 5) Sucker at a decided distance from the female gonopore and situated near the posterior margin of the body."

Of the above five points 2) and 4) can be seen in *Prosthiostomum* as especially pointed out in the preceeding species in this paper. In studying *Euprosthiostomum viscosum* from Napoli Palombi (1936) emended 4) as follows: " The proximal part of the vagina directed forwards or backwards ". The present species agrees well *Euprosthiostomum* in this feature, but differs from it in 1) and 5). At any rate this worm seems to be an intermediate form between *Prosthiostomum* and *Euprosthiostomum* and I would rather put it in the former genus than in the latter.

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ABBREVIATIONS

AGM accessory gland of male genital organs; AM antrum masculinum; AV accessory vesicle; BC bursa copulatrix; BR brain; CG cyanophilous gland; CR cirrus; CRC cirrus cavity; CUD common uterine duct; ED ejaculatory duct; EPR extracapsular prostate gland; FGP female genital pore; FSV false seminal vesicle; GIC genito-intestinal canal; GP glandular pouch; GVC genito-vaginal canal; GVF glandular vesicle of female genital organs; IN intestine; LGV Lang's glandular vesicle; MGP male genital pore; MO mouth; MW muscular wall; PA parenchyma; PH pharynx; PN penis; PNS penis sheath; PRG prostate gland; PRV prostate gland vesicle; SC seminal canal; SEG subepithelial gland; SGD shell gland duct; SGP shell gland pouch; SHG shell gland; SK sucker; SR seminal receptacle; SV seminal vesicle; TE tentacle; UT uterus; VB vagina bulbosa; VE vagina externa; VI vagina interna; ♂ male genital pore; ♀ female genital pore.

EXPLANATION OF PLATES

PLATE XX

1 *Stylochus speciosus* sp. nov. ×1
2 Ditto, longitudinal section through genital organs. ×40
3 *Cryptophallus eximius* sp. nov. ×1
4 Ditto, a part of longitudinal section of body showing penis. ×26
5 Ditto, longitudinal section through genital organs showing folded epithelium of vagina and opening of common uterine duct. ×26
6 *Discostylochus yatsui* sp. nov. ×1
7 Ditto, longitudinal section through genital organs. ×40
8 *Cryptocelis littoralis* sp. nov. ×1
9 Ditto, longitudinal section through genital organs. ×15

PLATE XXI

1 *Paraplanocera rubrifasciata* sp. nov. ×1
2 Ditto, longitudinal section through genital organs. ×26
3 Ditto, longitudinal section through genital organs showing glandular vesicle. ×40

4 Ditto, a portion of longitudinal section of body showing bursa copulatrix and seminal
    receptacle. ×26
5 *Stylochoplana clara* sp. nov., longitudinal section through genital organs. ×60
6 *Planocera profunda* sp. nov. ×1
7 . Ditto, longitudinal section through genital organs. ×40

PLATE XXII

1 *Prosthiostomum yerii* sp. nov., anterior end of body. ×15
2, 3   Ditto, longitudinal section through genital organs. ×40
4 *Prosthiostomum ostreae* sp. nov., anterior end of body. ×15
5 Ditto, longitudinal section through genital organs. ×40
6 *Prosthiostomum purum* sp. nov., anterior end of body. ×26
7 Ditto, longitudinal section through genital organs. ×40
8 *Prosthiostomum auratum* sp. nov., median sagittal section of body. ×40
9 *Pseudoceros sagamianus* sp. nov. ×1
10, 11   Ditto, longitudinal section through genital organs. ×26

SHG   SGD   CRC

LGV   ♀   ♂   AGM   PRV   2

GVF   CRC

♂   3

SR

BC   SC   4

LGV   PN   PRV

♀   SGD   GP   ♂   SV   5

6

SGD   CRC   PRV

♀   VB   ♂   SV   7
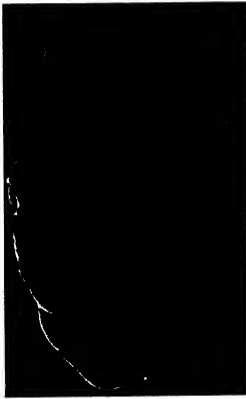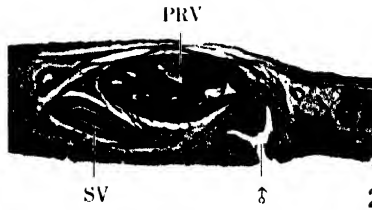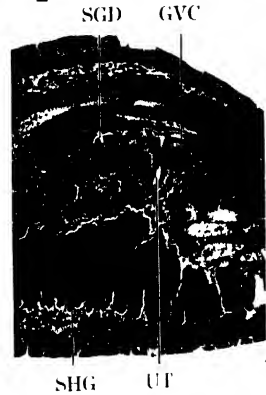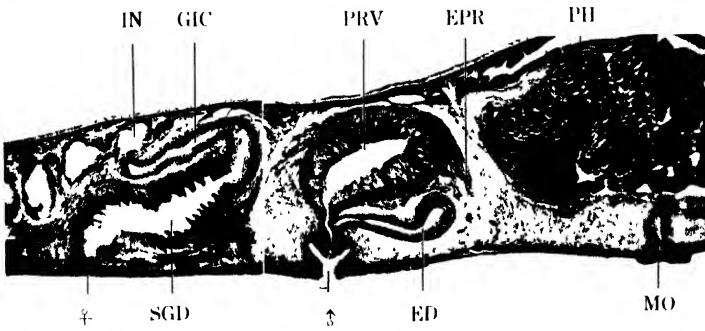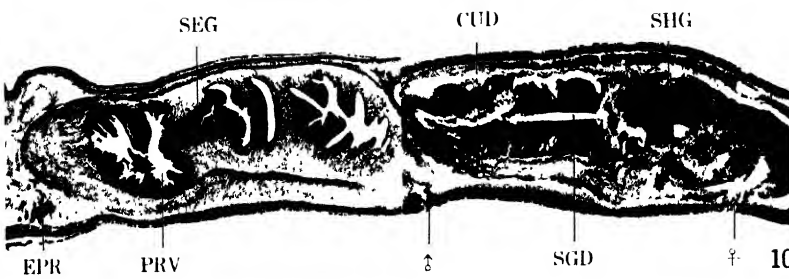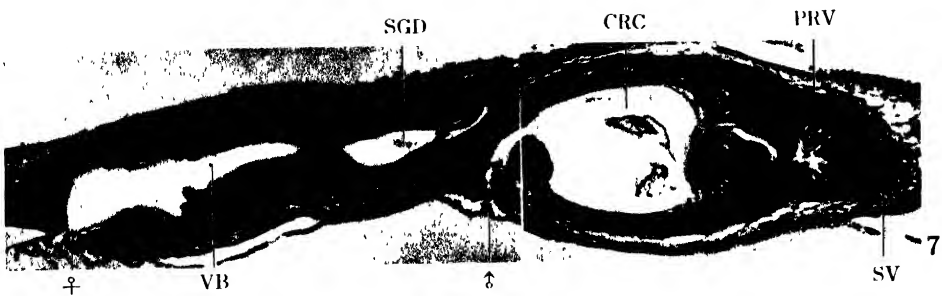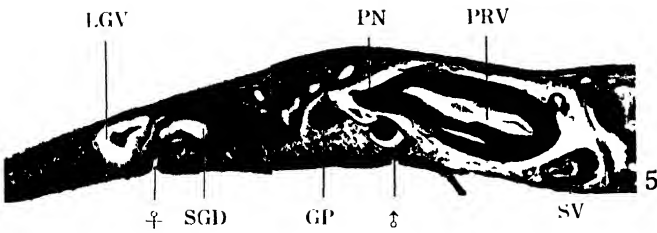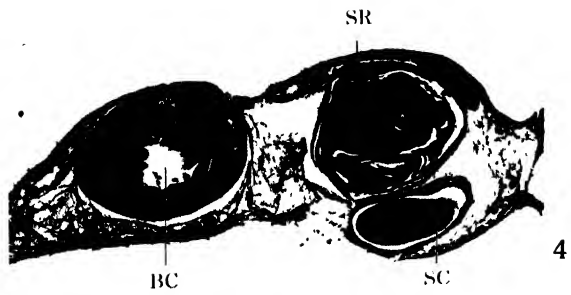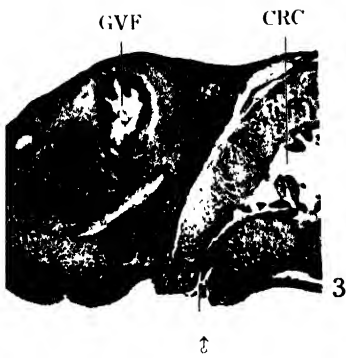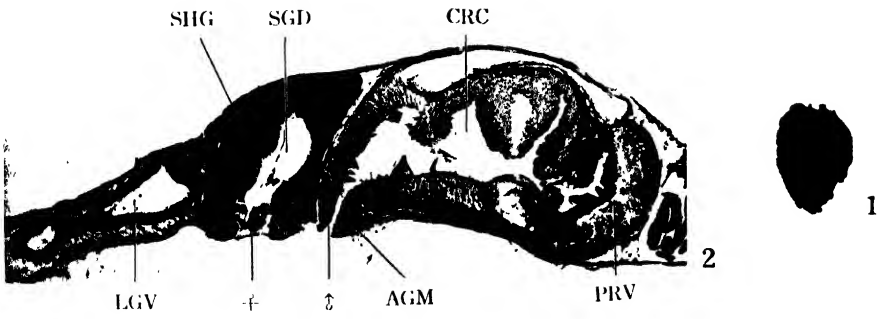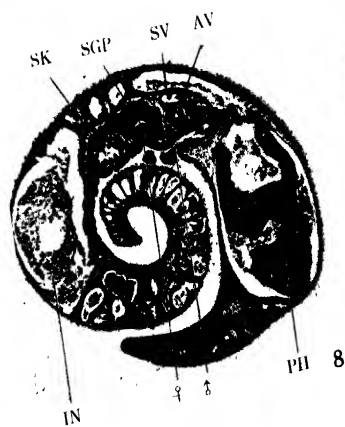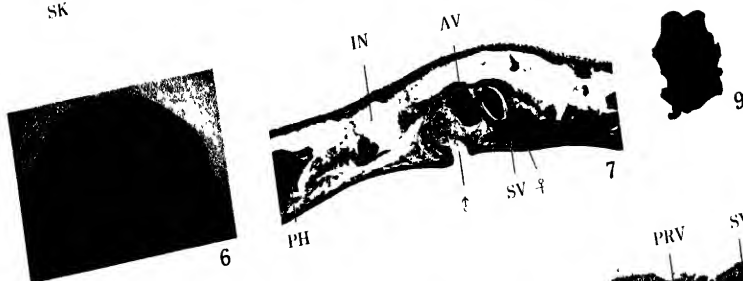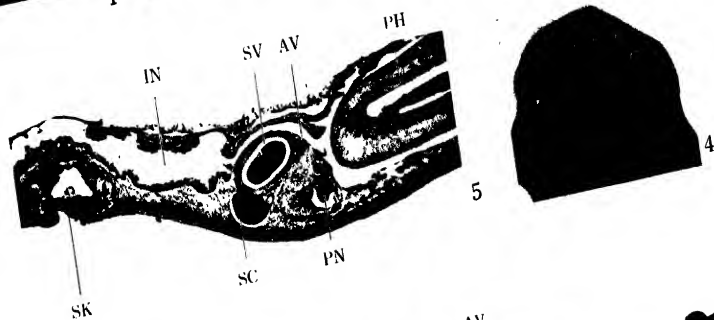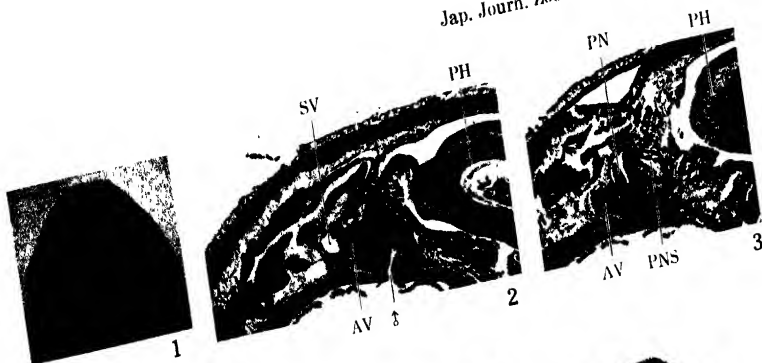
18.   Transplantation Experiments in *Planaria gonocephala* Dugès

By Yô K. Okada and Hisao Sugino

(Zoological Institute, Kyoto Imperial University)

(With 118 Figures in the Text)

CONTENTS

INTRODUCTION

I. Grafting experiments in planarians have been carried out since T. H. MORGAN began them in 1900. In one of his experiments two beheaded individuals of *Bipalium kewense* were united by their anterior cut surfaces, but in another the posterior ends of two short pieces were united. In either case no regeneration occurred at the junction. Later the composite animal was cut apart by an oblique section that passed across the line of union, so that each piece retained at its most distal point (at one side) a piece of the other individual in a reversed position. As a result a head in the former and a tail in the latter were produced. Regeneration in either case was obviously heteropolar to the small portion that was retained. But in these methods of experimentation it remains in doubt, whether the regeneration occurred in reality only from the small piece of tissue of another individual which was situated at the end, and whether the larger piece of tissue which was exposed on the cut surface did not participate in the process. Hence L. V. MORGAN (1906) cut *Phagocata gracilis* and *Planaria maculata* at different levels, i. e. just behind the eye (anterior level), in the middle of the pharyngeal sheath (middle level) or behind the pharynx (posterior level), and used any two of these as components. After heteropolar union by their anterior ends, one of the components was cut off near the line of union. It was observed here that the regeneration at the posterior end of the small piece was often reversed by the influence of the larger constituent. LUS (1924) cut a tail bipolar individual, which was derived from an experimentally produced two-tailed specimen of *Bdellocephala punctata* (autocomplantation or idioplastic reindividualization), near the line of union, and obtained in one case a head on the posterior cut surface of the shorter constituent. But LI (1928), who carried out these experiments on *Planaria lugubris*, never obtained any case in which the reversal of polarity in one component is caused by the influence of the other.

Reversal of polarity in a graft is explained by SANTOS (1931) as follows: That regeneration is reversed as regards the polarity of the shorter component is not by itself a proof of an induction by the larger component. For even very short pieces of a planarian are by themselves capable of giving rise to bipolar forms. Thus the reversal of polarity in the shorter component united in opposite direction represents no more, at the time of the determination of polarity in the newly formed tissue, than the influence on the posterior (or anterior) cut surface of the anterior (or posterior), where regeneration is inhibited by the presence of the larger component. But whether the reversal of polarity above observed in the graft piece is brought about, as SANTOS states, by the same set of conditions as a heteromorphic regeneration in short isolated pieces, is a problem which requires further consideration.

II. As SANTOS himself acknowledges, there are other cases of polarity reversal which are caused by transplantation. That in the experiments of L. V. MORGAN above described, besides the mere fact that of a pair of components united one is larger than the other, difference of the levels to which these components belong plays an important rôle, can easily be seen from her results. Also as indicated in the experiments of transplantation of small pieces by MORETTI (1912, in *Planaria torva, Pl. alpina, Polycelis nigra*) and SANTOS (1931, in *Planaria dorotocephala, Pl. maculata*) as well as in the results of GEBHARDT's experiments with regeneration buds (1926, in *Planaria lugubris*) different regions of a planarian show by no means uniform differentiation. The potency of head formation decreases from the anterior towards the posterior end of the body, while that of tail formation, on the contrary, being strongest at the posterior end, decreases towards the head. For the explanation of these regional differences we are not forced to assume settled differentiation at different levels of the body. The fact may easily be understood as manifestation of gradients, as CHILD and his adherents claim, a physiological dominance being represented at one end of the body. But it is also known that either on isolation or on heterotopic transplantation the head or the tail can form nothing more than its own, i. e. regeneration is unipotential. Though the morphogenetic potency of the newly formed tissue in the regeneration of these regions may at first be indifferent, its determination implies no more the dominance of the organism as a whole, but lies evidently in the graft itself. Moreover, if a head piece be taken as the graft, it demonstrates the capacity to establish a new polarity in reorganizing the host tissue behind it. According to GOETSCH (1929) the reorganization does not involve the host entirely, but is restricted to those portions which are drawn out of the host as the graft develops. SANTOS (1929, 1931), however, drew attention to the fact that the ganglionic region, if transplanted, not only induces an outgrowth from the host tissue, but also causes the tissue organization of the host itself to alter with the resulting reversal of the polarity. As was already shown by CHILD, the formation of a head represents, even in the ordinary regeneration process of an isolated piece, a motive force for the morphogenesis of the posterior regions. Thus the head of a planarian resembles the upper lip of the blastopore in the early development of amphibians and other vertebrates (SPEMANN 1916; in bird WADDINGTON 1933; in fish LUTHER 1935) in having a sufficient effect as an organizer upon undifferentiated tissues. But this phenomenon can not be attributed to a special function of the ganglionic region, for it was shown by OKADA and SUGINO (1934) in *Planaria gonocephala* that the prepharyngeal tissue, if transplanted into the postpharyngeal region, derives the appearance of a new pharynx as well as the ganglionic graft does. We are led by this fact to a belief that the reorganization of tissue and the induction of pharyngeal development are aroused, at least in planarians, by some change in the physiological gradients that are continuous from one end to the other.

III. GOETSCH (1921, 1922) regards the formation of new tissue (" Regeneration " in his own words) and the union (" Verwachsung ") to be antagoni-

stic to each other, for if two postpharyngeal pieces of *Planaria lugubris* are brought into heteropolar union by their anterior ends no "Regeneration" occurs between them. But Lɪ (1928), who has repeated the same experiment, comes to the conclusion that such a relation can hold only when there exists both structurally and materially no defect between two components. Thus, if a piece from the middle region of a planarian is removed and the remaining anterior and posterior parts are united, even in those cases where the latter are completely healed with no perceptible wound, the middle portion that is lacking comes to be repair by the formation of new tissue, i. e. through regeneration as it is called by the author. As regards the case of GOETSCH above mentioned of the heteropolar union of tail pieces, he further contends that inhibition of regeneration is not here due to the union itself, but to the condition that the polarity of each component is opposed to that of the other, i. e. to the hetero-polarity. SANTOS (1931) also observed that, if a piece other than the head is transplanted into another region of the body and the union is complete, new tissue is always formed between it and the host. But he calls attention to the fact that, if instead, a head piece is used as the graft, it directly reorganizes the host tissue, and such formation of new tissue as above does not follow.

IV. Now, the methods and aims of our experiments which were carried out during the five years from 1930 to 1935 were as follows: 1) Small square or rectangular pieces were cut from different levels of a planarian and transplanted into the same (autoplastic transplantation) or another individual (homoplastic t.) at different levels either in normal or reversed orientation. The object of this series of experiments was to determine the degrees of specialization from the head to the tail end of the animal. On the other hand, parts were united, which were thus known to be provided with different specialization, in the hope that some new light might be thrown on the problem above discussed as to the various influences on the host. In such cases it is evident that the graft itself will be influenced by the host according to the level of transplantation. It is also necessary in these experiments to take into consideration the effect of quantitative difference between the sizes of the graft and the host. 2) Hence, two pieces of comparatively large size cut out at the same or at different levels of the body were united in normal or reversed orientation, and in the light of these experiments the results of the preceding experiments of transplantation of small pieces were criticized. Again, subsequent cuts were performed in these experiments for the purpose of investigating that in what manner the difference in size and degree of specialization between the components of the compound body determine in particular the polarity of the regenerated part on the operated surface. 3) Homopleural or heteropleural reindividualization was made with lateral halves of two worms which were longitudinally split. This implies combination of the results of the first series of experiments with those of the second, representing the union of two halves with equal or unequal differentiation along a wide range from one end to the other of the worms, with the aim of elucidating the mecha-nism of subsequent reorganization of tissue and the formation of new organs.

The results of these experiments were already briefly reported in Proc. Imp. Acad. Tokyo, X (1934) pp. 37–40, 107–110. In the following pages the whole aspect of our study will be published, since some deficiencies in the preceding paper could be filled up through the experiments continued during the course of the following year.

MATERIAL AND METHODS OF EXPERIMENTS

As the material was used *Planaria gonocephala* which is the most common in this locality and can easily be collected and cultured. The experimental animals were preserved in glass vessels, 20 cm. in diameter and 10 cm. high, each containing about 100 individuals. Water was changed during summer once a day and during winter once every third or fourth day. The untouched animals as well as those operated were fed with hen's liver once a week.

Planaria gonocephala in the vicinity of Kyoto being seldom provided with sexual organs, asexual worms only were employed in the experiments. Preserved specimens of the planarians multiplied vigorously even in the laboratory, fission taking place usually immediately or a little behind, rarely before, the pharynx.

Worms 10–18 mm. in length were chosen for operation, but those under 5 mm. were also occasionally employed. Those which were used as hosts were anaesthetized in an aqueous solution of chloretone (0,2–0,4%) and put on a glass plate which had been immersed in melted paraffin and thereafter covered with a thin layer of gelatine. With a sharp scalpel for ophthalmic use under the binocular microscope, a hole was cut at a certain level of the host body in the shape of a square (one side about 1 mm. in length), into which a piece from the same or another individual (auto- or homoplastic graft) was inserted with a certain orientation. In homoplastic transplantation, it is to be mentioned, the graft was taken from a worm not anaesthetized. Operation being ended, the worm was put on a watch glass with a little moisture, and was kept in the dark for over 24 hours in a small moist chamber. Sometimes the watch glass was lined with wet filter paper and the operated specimen was put on it. But even when the paper was not in use, the worm was kept wet enough because of water drops condensed upon the watch glass by lower nocturnal temperature, never coming to be dried up so as to cause death. Operated animals were sometimes covered also with tissue paper. In summer months they were put into a refrigerator in order that maceration of the cut surface might be prevented. In most cases, it is to be added, the host was beheaded to be kept quiet.

Although not necessary in the case of small pieces, when two large pieces were to be united measures must be taken for preventing the gliding apart of the surfaces of contact. For this purpose one cut surface was previously made convex and the other concave. When two halves from worms which were longitudinally split through the median plane were united parallel with each other in normal or reversed orientation, the compound

formed by their union was always covered with tissue paper, the outer portions of which, moreover, were weighted with fragments of glass.

Each worm on which transplantation had proved successful was put in a Petri-dish, observed every day under the binocular microscope, recorded and, if necessary, sketched.

A glass plate covered with a thin layer of paraffin on which a gelatine solution (2 g. of gelatine in 100 cc. of tap water) is poured and dried up into a thin layer makes operation which is performed upon it very easy. The worm adheres, as if pasted, to the plate, as the moisture on the ventral surface of the body is absorbed through the latter. This makes it very easy to operate upon a worm at any level and in any direction with a scalpel. Though the mucus secreted all the time from the surface of the worm offers an obstacle to the union of the graft and the host, it is nevertheless beneficial for preventing the worm which is exposed to the air from desiccation.

TERMINOLOGY IN EXPERIMENTS

The pharynx serving as a landmark, those parts of the body lying anterior and posterior to it are called respectively the prepharyngeal and the post-pharyngeal regions, while the middle part including the pharynx the pharyngeal region. If necessary, each of these regions is distinguished into subdivisions, i. e. anterior, middle and posterior, with the exception of two extremities which are the head and the tail.

By transplants or grafts are meant, of course, small pieces used for transplantation, and by recipients or hosts worms that receive them. So far as the prepharyngeal (*AP*) or the postpharyngeal region (*PP*) is concerned, the point at about the centre in each region is chosen in our experiments as the level of transplantation (fig. 1 b). Pieces which are used as grafts in our experiments are the following. From the head region: piece in front of the eyes (preocular graft, fig. 1 a, *a*), ganglionic portion including the eyes (ocular or ganglionic graft, *g*) and auricular portion on either side (auricular graft, *l*). From the prepharyngeal region: its middle portion (prepharyngeal graft, *ap*) and piece just before the pharynx (*ph. a*). From the pharyngeal region (*PH*): basal portion of the pharynx (pharyngeal basis, *ph. b*) and portion in the middle of the region (midpharyngeal graft, *ph. m*). From the postpharyngeal region: its middle portion (postpharyngeal graft, *pp*) and piece near the tail end (tail graft, *t*).

As regards the manner of union, those cases in which the polarity of the graft is identical with that of the host, i. e. both are in the same direction, are spoken of as in normal orientation, while those cases in which the polarity is opposite to each other as in reversed orientation. Sometimes, terms isopolar and heteropolar directions are used in their places. In the cases where large pieces are united, it is needed to designate not only the direction but also the original position of each. A piece is said to be in normal anteroposterior (*a-p*) orientation, when it is set with normal orientation into the level corresponding

to its original position, or in normal posteroanterior (*p-a*) orientation, when it is united according to its original polarity, but the position is changed antero-posteriorly. When large pieces are united in reversed orientation, there are distinguished anteroanterior (*a-a*) union, where two pieces unite on their anterior cut surfaces, and posteroposterior (*p-p*) union, where they unite on their posterior cut surfaces.

Finally, dorsoventral differentiation is so significant in planarians that, if a graft is transplanted in reversed vertical orientation, no reversal in property can occur either in the host epithelium or in the graft epithelium to that of the other side (cf. the results of experiments by L. V. MORGAN, 1906 and also by SANTOS, 1931). Hence, these points must be brought out more clearly before we proceed to give accounts of our operations. Those cases in which such a vertical reversal does not exist are called dorsodorsal (*d-d*) or vertically normal transplantations, distinguished from the opposite cases which are called dorsoventral (*d-v*) or vertically reversed transplantations. Besides, explanations on different modes of " takes " will be given occasionally.

Fig. 1. *Planaria gonocephala* Dugès, showing a) pieces of transplantation and b) levels to be transplanted. Abbreviations: *a* preocular graft, *AP* prepharyngeal region, *ap* prepharyngeal graft, *g* ganglionic graft, *H* head region, *l* auricular graft, *PH* pharyngeal region, *ph* pharyngeal graft (*a* immediate anterior, *b* basal, *m* middle), *PP* postpharyngeal region, *pp* postpharyngeal graft, *T* tail region, *t* tail graft.

EXPERIMENTS

I. TRANSPLANTATION OF SMALL PIECES

Generally speaking, there are two different modes of union which occur between the transplanted piece and the host: first, the dorsal and the ventral epithelia of a graft unite in the normal way with the dorsal and the ventral epithelia respectively of the host (dorsodorsal ventroventral (*dd-vv*) union), and vice versa (dorsoventral ventrodorsal (*dv-vd*) union); second, both the dorsal and the ventral epithelia of a graft unite merely with either the dorsal or the ventral epithelium of the host (dorsal-ventral dorsal (*dv-d*) or dorsal-ventral ventral (*dv-v*) union). These different modes of union result in profound differences in further development of the graft. When a graft perfectly unites with the host, i. e. the cut surface of the former perfectly unites with the host tissue on all sides, the graft piece will cause an elevation on either the dorsal or the ventral surface, a corresponding invagination of various degrees taking place on the ventral or the dorsal surface. At the time when the elevation or the invagination is not yet formed, if we cut the host

animal anteriorly or posteriorly to that level so that an original cut surface of the graft may be exposed, regeneration takes place at this end either independently or in cooperation with the host tissue.

Between the graft and the host can occur, of course, incomplete union of every sort, accompanied according to its degree with various morphogenetic effects.

A. Head Grafts

In most cases a rectangular piece including the eyes and the brain was used as the graft (fig. 1 a, g). Such a head piece cut apart just behind the eyes is by itself no more able to regenerate tail. But if possessed backwards of a short postcephalic part, it regenerates tail as well as pharynx. We have not yet experienced any production of a heteromorphic head by an isolated head piece of *Planaria gonocephala*.

1. Transplantation of the ganglionic piece into the prepharyngeal region

Out of 28 cases in all of successful transplantation, resorption of the graft by the host occurred in one case only. Here also, the graft which was transplated into the subocular position of the host developed once into a perfect head. But as another head regenerated from the anterior end of the host grew, the graft head gradually decreased in size and was ultimately resorbed. In the remaining cases a head, perfect or imperfect in different degrees, developed from the graft. The experiments and their results are summarized in table I.

Table I

Transplantation of Ganglionic Piece into Prepharyngeal Region.

Experiments			Results						
			Normal Head			Heteromorphic Head			Resorption
Mode of Union	Secondary Operation	Number	Plane	Dorsal Out-growth	Ventral Out-growth	Plane	Dorsal Out-growth	Ventral Out-growth	
Union complete	Not performed	1						1*	
Union complete	Cut anteriorly	4	3			1			
Union complete	Cut posteriorly	1	1						
Union incomplete	Not performed	9		3			5	1	
Union incomplete	Cut anteriorly	5		2			2		1
Reversed dorso-ventrally		3		1			2		
Part of Graft not united		5				4		1	

Ventral elevation

Cases in which union is complete: Union after operation between graft and host being complete, as we have already stated, a dorsal (or ventral) elevation accompanied with a corresponding ventral (or dorsal) invagination occurs at the level of transplantation.

If the host is cut just before the graft which is transplanted in normal orientation, a head regenerates from the latter and replaces the host head. Fig. 2 represents such a case in which new tissue (*nt*), though in a small quantity, is formed along the line of union between the graft and the host.

In case, too, a graft is transplanted in reversed orientation into the host, if after union the latter is cut anteriorly, a head is regenerated from the original posterior end of the graft and dominates over the regions that follow. In fig. 3 is illustrated a case in which a head is regenerated from the common cut surface consisting of the posterior end of the graft and the anterior one of the host, and, moreover, new eyes are formed in front of the old ones so that two eyes are now situated antero-posteriorly on each side. The eyes on the right side are, however, found in a common white area.

In fig. 4 is shown the result of trans-plantation of a head piece into the host nearly at right angles to the long axis of the latter, of which after union the anterior portion was cut off. In this case, on the cut surface the left side of the graft was exposed, from the anterior angle of which the graft gradually turned forwards. Although the eye spots, accordingly, drew nearer to the normal situation, they could not reach it even in 42 days after trans-plantation. A supernumerary pair of small eyes then developed besides the original ones as illustrated in the figure.

Figs. 2–4. Results of transplantation of a head piece into the prepharyngeal region in normal (fig. 2), reversed (fig. 3) and rectangular direction (fig. 4), and subsequent removal of the host part anterior to the graft, original polarity of the latter being indicated by an arrow; fig. 2, 11 days; fig 3, 31 days; fig. 4, 42 days after the first operation. *nt* new tissue appeared between host and graft.

In the foregoing two kinds of transplantation, i. e. in normal and reversed unions, if the portion lying behind the graft is cut off, the latter develops into a head turned backwards (OKADA and SUGINO 1934, I, fig. 1). In fig. 5 is shown such an example where, though regeneration occurred to a slight extent from the host tissue on both sides of the cut surface, the new product could develop into neither a tail nor a head. In this experiment also, there could be recognized no reorganization of the anterior branch of the intestine lying between the host head and the head grown from the graft in the reversed direction. Hence in these worms, provided with neither pharynx nor mouth,

waste products of the body wholly accumulate in the old intestine as is shown black in the photograph of the figure.

Cases in which union is incomplete: In case both the dorsal and the ventral epithelia of a graft are united merely with either the dorsal or the ventral epithelium of the host, the graft develops, regardless of its orientation, always at right angles or nearly so to the dorsal or the ventral surface of the host. Here also, differences in the mode of development of the graft depend, needless to say, upon the mode of union between the graft and the host.

Fig. 5. In the same transplantation as before posterior part of the host was removed, with resulting production of a head at the posterior end.
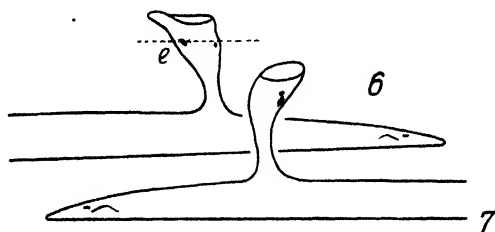
Figs. 6-7. Dorsal outgrowthes as a result of union of both dorsal and ventral epithelia of the graft with the host dorsal epithelium; fig. 6, 26 days; fig. 7, 28 days.
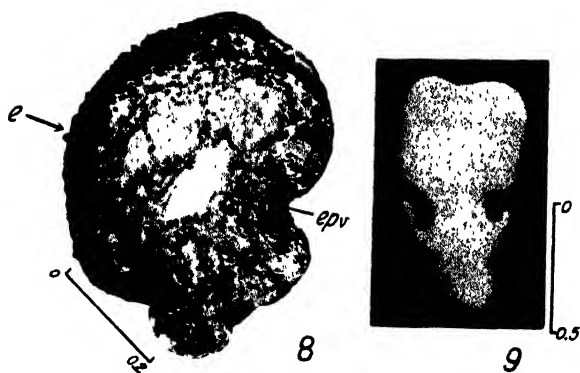
Fig. 8. Transverse section through the ocular level of the head in fig. 6; *e* eye, *epv* graft ventral epithelium. Fig. 9. Head cast off from the specimen in fig. 7.

In those cases where most of the dorsal epithelium of a graft is united with the dorsal epithelium of the host and most of the ventral epithelium of the former is buried in the parenchyma of the latter, the graft develops into a tubular form. If the ventral epithelium of a graft is buried to a lesser extent, the greater part being exposed to the exterior, the graft develops into a funnel or cup-form, the inner surface of which is lined with the ventral epithelium of the graft origin. Figs. 6 and 7 represent such examples. In fig. 8 is given a cross section of the graft of fig. 6 at the ocular level. Fig. 9 shows the graft head detached from the worm of fig. 7.

In a specimen in which union of the graft dorsal epithelium with that of the host was complete and the graft ventral epithelium was entirely buried in the host body, an opening abruptly broke out the line of union during the

development of the dorsal elevation, resulting in the exposure of the graft ventral epithelium to the exterior (see fig. 10).

The stalk or peduncle of the graft head which has grown into a funnel- or a cup-form is covered with the host dorsal epithelium. It becomes thinner as time passes, and finally breaks off at the place where it is thinnest. Detached heads are not provided with the power of regeneration and are dead in a few days. In figs. 11, 12 and 13 are shown specimens in which the graft had developed to a certain extent, and yet in these cases the graft was finally detached through the dwindling of the stalk. Here, during the development,
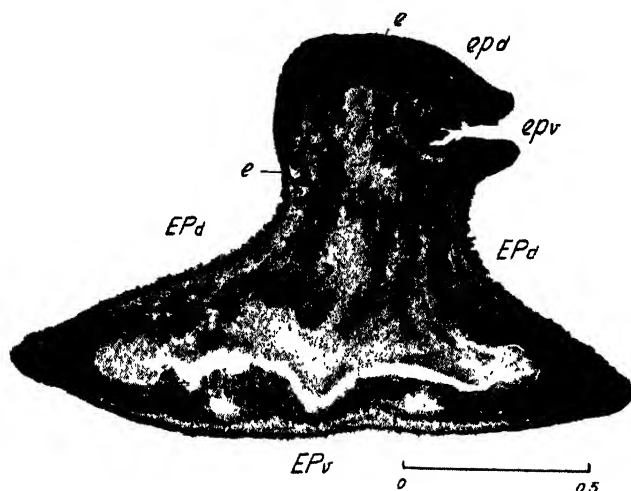
Fig. 10. Transverse section of a specimen in which union of the graft dorsal epithelium (epd) with that of the host (EPd) is more complete, and the enclosed ventral epithelium of the graft (epv) breaks through to open to the exterior; e eye, EP host epithelium, ep graft epithelium, d dorsal, v ventral.

besides the original ones, one or two new eyes were formed in the old tissue of the graft (figs. 11, 12) or in the outgrowth from the host (fig. 13). A graft head thus provided with excess eyes, if detached from the host, often develops into a biaxial head. In the specimens represented in figs. 11 and 12, some changes in relation to the original longer axis are observed in the graft head. Generally speaking, no matter in what orientation a graft head may be united with the host, the end which has remained free always develops into the anterior end of the head developed therefrom. That is to say, a head piece is endowed with the potency to differentiate in any direction into a head. To such polygonal heads developed from the head grafts SANTOS (1931) applied the term " multipolar ".

Dorsoventral reversal: Dorsoventral reversal of the graft is accompanied also according to the mode of union with diverse results. If the graft ventral epithelium is brought into complete union with the host dorsal epithelium, an elevation is formed with its margin represented by the line of union. Eyes

are formed in the host dorsal epithelium. The inner surface of the cup-shaped region is lined with the graft ventral epithelium. In the specimen represented in fig. 14, eyes were formed in the host dorsal epithelium, one pair of them anterior and the other posterior to the graft ventral epithelium, while the old eyes of the graft themselves still remained, but were in the process of degeneration. Fig. 15 shows a specimen in which a graft with reversed dorsoventral orientation developed on the ventral side of the host, the dorsal epithelium of the former being surrounded by the ventral epithelium of its own and that of the latter. While the original left eye (*le*) had been left behind during the development of the graft, another left eye (*e*) was newly formed, constituting a pair with the original right eye (*re*), which was then brought forwards by the development of the graft. Similar results were obtained in many other cases. In fig. 16 is given a specimen in which after union of a graft in reversed dorsoventral orientation the anterior portion of the host was removed at the level of transplantation. A perfect head, though reversed, was formed by the graft itself, while none was regenerated from the host.

Figs. 11-13. Incomplete unions of a head piece in the prepharyngeal region; fig. 11, transplantation in the rectangular direction, union taking place only on the right side with the host dorsal epithelium, 25 days. Fig. 12, transplantation in oblique direction, 8 days. Fig. 13, in reversed orientation, 36 days in lateral view.

Figs. 14-16. Dorsoventrally reversed head pieces in the prepharyngeal region; fig. 14, 29 days. Fig. 15, graft grown out to the ventral side, 31 days. Fig. 16, regeneration inhibited on removal of the anterior part of the host, 80 days. *le, re* left and right eyes of the graft, *e* new eye.

Polarity reversal: Only in one among 28 cases, as the result of transplantation of the head piece, did polarity reversal at the time of regeneration occur on the anterior cut surface of the host. This is shown in fig. 17. On the 26th day after a head piece was united with the host, a cut was made on the latter just before the former (indicated in fig. 17a by a broken line). A tail, instead of a head, regenerated at the anterior end of the posterior large portion of the host which was in connection with the graft. This was followed

even with the formation of a small pharynx (figs. 17 b, 18 *ph*). As the regeneration was in progress, the grafted head continued to grow dorsally and was finally cast off, the narrow portion of the peduncle becoming thinner and thinner. It remains, to our regret, still uncertain, whether, in the case in question, the regeneration of tail took place under the influence of the graft head, or whether, instead, a true heteromorphic tail regenerated because of polarity reversal on the part of the host itself.

Formation of new eyes: Formation of new eyes in planarians is, GOETSCH (1921) says, only possible in newly regenerated regions, but not in old ones. Nevertheless, it does, beyond any question, often occur in the graft heads as well as in the host tissues in their neighbour, as indicated already in the preceding examples. Formation of new eyes, now, is closely associated with the change of axis which takes place in developing grafts. In the case shown in fig. 19, for example, the graft head united at first by the left cut surface with the host body grew gradually forwards, accompaning the host tissue, from the free end at the right (fig. 19 a). In fig. 19 b is indicated the state of the graft head on the 25th day after operation. Besides the original eyes *r* and *l* which were now situated anteroposteriorly,

Fig. 17. Polarity reversal; a, head developed on the dorsal side of the prepharyngeal region as the result of transplantation of a head piece in anteroposteriorly reversed orientation, union incomplete, 26 days in lateral view. b, on removal of the anterior part of the host tail regenerated instead of head on the anterior cut surface, 79 days from the beginning in dorsal view. Grafted head has been cast off in the course of time, the position being indicated by dotted area close behind the new pharynx (*ph*).

Fig. 18. Median horizontal section of the same specimen as in the preceding figure, showing the internal structure; *PH* old pharynx, *ph* new pharynx, *T* old tail, *t* new tail, *tr* position of transplantation.

new eyes r_1 and l_1 were formed in symmetrical positions in relation to the longer axis that was newly set. The graft head continued to grow larger into a cylindrical form. After 10 days an eye (fig. 19 c, r_2) and a white area appeared between the anterior pair of eyes (*r* and r_1) and a few days later another new eye (l_3) on the outside of the old one (*r*). The cylindrical head which had then grown laterally to a considerable extent burst into

a plane on the ventral surface from the right lateral corner which was in contact with the host, and the host head turned simultaneously to the left as indicated in fig. 16 d. Hence a T-shaped bicephalic form resulted. As stated above, if in a graft head of *Planaria gono-cephala* change of polarity takes place before its development, regeneration that follows and, at least, formation of eyes are wholly under the control of the axis which is newly set: the original symmetrical relation to the old pair of eyes becomes abandoned, and eyes are formed in new positions symmetrical to each other. If during the development of the head the symmetrical relation is subjected to further anomaly, or if it is incomplete from the first, new eyes are formed once more in a new symmetrical relation and so on, regulation being continued until ultimate stability is reached.

Fig. 19. Formation of extra eyes each time of changing direction in which the grafted head develops, transplantation being oblique and union taking place only on the left side of the graft; *l* old eye on the left side, *r* that on the right side, l_1, l_3 new eyes developed on the left side, r_1, r_2 those formed on the right side. a, 16 days; b, 25 days; c, 45 days; d, 51 days.

2. Transplantation of the ganglionic piece into the postpharyngeal region

In 5 out of 22 specimens, the graft was united merely with either the dorsal or the ventral epithelium of the host; the head developed therefrom was in connection with the host by a narrow peduncle, as in the cases of transplantation into the prepharyngeal region. It was cast off ultimately from the host in 2 specimens. In the remaining 3 cases also, which were fixed for the investigation of internal structures, the tendency of the head to be cast off was obvious. In these examples the influence of the graft was only recognized in a restricted region of the host in contact with the former, with nothing more worth mentioning.

In the transplantion of a head piece into the prepharyngeal region, resorption of the graft never takes place. Moreover, except in the preceding cases of imperfect union, two new pharynges are induced, so far as union is complete, in the old tissue of the host, one anterior and the other posterior to the level

of transplantation, regardless of the orientation of the graft and no matter by which out of its four cut surfaces the graft is united with the host, as was already shown by SANTOS (1929, '31) with numerous examples.   New tissue also appears around the graft.   Though it is not yet quite clear, whether it is derived from the host or from the graft, it is in this region (post-pharyngeal) probably of the host origin.   As an attempt to come nearer to the question, pieces stained *intra vitam* with a dilute aqueous solution of Nile blue sulphate were used as grafts, but they did not prove to be of any direct service for solving the question.   The new tissue, in fact, was stained blue, but it does not necessarily follow from this that it was derived from the graft, for, on grafting a stained piece, diffusion of the dye by itself into the host tissues is evident at first sight.   The experiments and their results are summarized in table II.

Table   II
Transplantation of Ganglionic Piece into Postpharyngeal Region.

Experiments			Results						
			Normal Head			Heteromorphic Head		Production of Pharynx	
Mode of Union	Secondary Operation	Number	Plane	Dorsal Out-growth	Ventral Out-growth	Dorsal Out-growth	Ventral Out-growth	One	Two
	Not performed	5				(2) Saccular	(3) Saccular		5
Complete	Cut anteriorly	1	1					1	
	Cut posteriorly	5	5					5	
Partial Union	Not performed	6	2	2		2		1	4
	Not performed	1					1		1
Incomplete	Cut anteriorly	1				1		1	
	Cut posteriorly	3	1	1	1				

Cuts made at the level anterior or posterior to the graft after transplantation: After a head piece is transplanted with normal orientation into the post-pharyngeal region, if the host body is cut in front of the graft, the latter develops into a complete head, dominates over the more posterior regions and induces development of the pharynx to complete the normal organization of a worm.   In fig. 20 is shown a specimen in which the graft had already induced a new pharynx in the host body before the cut was made.   Fig. 20 c represents the completed individual consisting of the postpharyngeal region from the host, which was cut anteriorly to the graft level, and the graft head situated in front of it.   Figs. 21, 22, 26, 28, 32, 34 and 35 are examples, in which by auto- or homoplastic transplantation of a head piece production of two pharynges opposite to each other was induced in the postpharyngeal region.

In these cases, no matter by which of the cut surfaces the graft was united with the host, the result of pharyngeal induction was always the same.

If the tail of the host is removed at a level posterior to the graft, a head appears in the opposite direction, with the induction of another pharynx in reversed orientation between the head and the host pharynx. Those cases which are represented in figs. 24, 25, 26, 29 and 30 belong to this category.
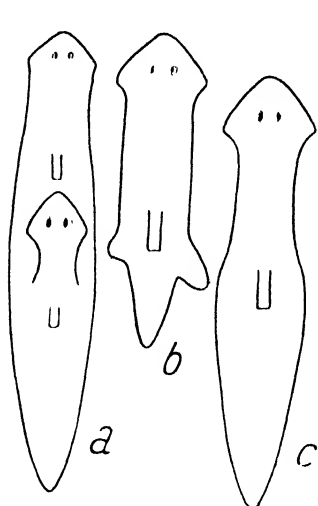
Fig. 20. a, 20 day old specimen with head graft in the post-pharyngeal region in normal orientation; b, anterior, and c, posterior parts of the same specimen 18 days after transverse cut in front of the graft.

Fig. 21–22. Transplantations of a head piece into the postpharyngeal region in reversed orientation; fig. 21, union complete, 16 days. Fig. 22 a, similar to the preceding, 20 days; b, tail regenerated to the anterior side of the posterior part cut separated behind the pharynx at the level of a dotted line in fig. 22 a, 105 days from the beginning.

If a cut is made in these specimens at a level somewhat posterior to the host pharynx, in most cases a tail, instead of a head, regenerates from the anterior cut surface of the posterior part (figs. 22 b, 33, 35 c).

In figs. 21 and 22 are represented two examples in which, after the graft was united by its posterior end with the host, new tissue appeared between them and an extra head was formed also from the host. When a cut was made at such a level as shown by a broken line in fig. 22 a, a tail regenerated from the anterior cut surface of the posterior part (fig. 22 b). Thus in transplantation of a head piece, reversal of polarity had evidently occurred at a portion of the old tissue of the host.

In fig. 23 is represented a case in which after union of the graft that portion of the host body which was posterior to the graft was cut off, and in

which after 9 days the anlage of the new pharynx already made its appearance. Fig. 24 is a sketch from a mounted specimen, which was operated in the same way and was fed with chick liver stained with carmine before fixation, to show the state of intestinal branching. Here, the existence of common posterior branches of the intestine between the old and the new pharynges can evidently be observed.

Fig. 25 shows a specimen, of which the anterior portion was cut off, after the posterior head and the second pharynx were induced by transplantation of a head piece at a level just behind the host pharynx (a), with the subsequent regeneration of a head at the anterior end. When a cut was made again afterwards on a plane through the new host pharynx (b), a head was regenerated as before and a pharynx, too, was formed once more. This specimen decreased in size, as time passed, and the two pharynges (one regenerated and the other induced in the reversed direction by the graft) drew nearer to each other.

Now, a case (fig. 26) happened, in which removal of the host head simultaneously with transplantation of a head piece was followed by the regeneration of an abnormal head

Figs. 23-25. Posterior exstirpations in the postpharyngeal transplantation of a head piece in reversed orientation; fig. 23, 35 days. Fig. 24, showing the intestinal branching in a mounted specimen. Fig. 25 a, transverse cut just behind the pharynx, 22 days after producing a posterior head; b, head regenerated, cut was made once again through the pharyngeal level after 25 days; c, head again regenerated, 131 days from the beginning.

with a single eye. An attempt was made to remove this head end. The cut surface was healed over and no regeneration took place. When this specimen was cut again after 20 days at a level just before the host pharynx, regeneration of the anterior part failed to occur as before. Further, at the place of transplantation the eyes of the grafted head were embedded in the tissue and new eyes appeared on the surface (fig. 26 a). Later on, separation from each other of the anterior and the posterior parts occurred at the level of transplantation. The anterior one was cut into sections and examined. It was observed, as

indicated in figs. 26 and 27, that two pharynges opposite in direction were piled up one upon the other, the reversed (*ph*) above and the normal (*PH*) below. Moreover, at the anterior end of the piece lateral nerve-cords on both

Fig. 27. Transverse section of the double pharynx in fig. 26.

Fig. 26. a, Head formation inhibited on the anterior side of the specimen with a head graft in the postpharyngeal region when cut was made in the prepharyngeal level, 152 days after transplantation; b, anterior part which was separated off. Notice the presence of two pharynges one upon another in a common sheath. *e* old eyes.

sides were connected together, and the intestine, from the posterior heteromorphic head to the pharynx, was full of cell débris. By the way, the worm was put previous to fixation into a suspension of carmine particles to study the ciliary movements on the body surface. Particles were observed to move backwards at the regions anterior to the middle of the pharynx, while they moved forwards at the more posterior regions.

Formation of supernumerary eyes:
We described already some cases of transplantation of a head piece into the prepharyngeal region, where besides the original eyes of the graft one to several eyes were formed. Also in the cases of transplantation of a similar head piece into the postpharyngeal region, formation of extra eyes occurred, depending upon which portion of the graft remained free and in what manner of union with the host. That change of axis had occurred in the graft could safely be inferred from this. In the case of fig. 28 in which the graft was transplanted in transverse direction into the host, union taking place merely on the anterior and the posterior cut surfaces, the graft began to develop from the free cut surface on the left side, i. e. from that portion directed forwards, and gradually lengthened in a direction at right angles to the host body (fig. 28 a). Concurrently a pair of eyes appeared on both sides of the original left (*l*), i. e. the anterior median eye (fig. 28 b), and somewhat later another pair of eyes on both sides of the original right (*r*), i. e. the posterior median eye, besides an extra eye on the right of the anterior median eye (fig. 28 c). In the case under consideration the head developed from the graft has turned

during the development about 90° from the original direction.   But structures of the head other than the eyes differed in no way from those of normal worms.

In fig. 29 is represented a case in which a head piece was grafted into the host somewhat obliquely to the longer axis. After development of the graft head, a new left eye was formed in front of the original one, constituting a pair with the right eye which was now situated more anteriorly.

In the case of fig. 30, a head piece was grafted into the same individual in normal orientation in the middle of the postpharyngeal region, and after union took place the tail was cut off, leaving the graft in connection with the main part of the body. As the result the posterior cut surface of the graft was exposed again, new tissue appeared in a small quantity, and a head in reversed orientation was formed.   Meanwhile, posteriorly (or anteriorly, if the regenerated head be taken as a landmark) to the pair of old eyes (e) another additional pair of new eyes (ne) appeared.   Though in this case the head newly formed and directed backwards is reversed

Figs. 28–31. Development of supernumerary eyes relating to the change of axis in growing head. Fig. 28, transplantation of a head piece into the postpharyngeal region in transverse direction, union taking place on lateral sides, while anterior and posterior sides remained free; a, head grown out in the anterior direction, 30 days; b, head turned to lateral side, two pharynges have been induced and new eye appears to the anterior median eye (l), 48 days; c, 5 extra eyes are formed besides the two old ones (l and r), 81 days. Fig. 29, posterior part of the host was removed in a similar transplantation of the head piece in reversed orientation. Head with 3 eyes resulted owing to obliqueness of the original transplantation, 14 days from the second operation. Fig. 30, Removal of the posterior part of the host after transplantation of a head piece in normal orientation, with the result of an appearance of pair of eyes in front of the old ones, 70 days. Fig. 31, New eyes appeared behind (front in figure) instead of before as in the preceding case; e old eyes, ne new eyes.

in relation to the original axis of the graft piece, it is quite normal in shape. If it is taken into consideration that, so far as formation of eyes is concerned,

those original to the graft are abandoned and new ones are formed, we are led to a position that the formation of the head in question probably represents regeneration of a head heteropolar to and independent of the graft one.

32a   tr   32b   33   34a   34b

In fig. 31 is represented a head which was regenerated in an experiment similar to the preceding one on the posterior cut surface of the host whose tail was cut off on the 9th day of transplantation. As in this case the host tail was cut behind the original pair of eyes and very close to these, regeneration was not accompanied with the formation of new tissue. Consequently, after the head was completed, the eyes were found too anterior in position in comparison with the normal. It means probably a correction to this that anterior (or posterior, if the regenerated head be taken as a landmark) to them three supplementary eyes (ne) were newly formed in the host tissue. Here, formation of supernumerary eyes took place behind, instead of before, as contrasted with the preceding case.

In the above cases also, development of a new pharynx was induced in the reversed direction at a level in front of the grafted head, as in the other cases already considered. In the case of fig. 28, moreover, two pharynges in opposite direction appeared, one anterior and the other posterior to the level of transplantation.

Cases without subsequent cut: Figs. 32, 33 and 34 represent cases of complete union of the graft with the host. Fig. 32 is the result

Figs. 32 34. Transplantations of a head piece into the postpharyngeal region in reversed orientation and union complete; fig. 32 a, the grown-up transplant projects on the ventral side like a pocket and two pharynges are induced, one before and other behind, 50 days, b, when the project is cut open (on 78th day from beginning), head comes out and flattens in a plane. In the specimen of fig. 33, anterior part of the host was cut off behind the pharynx and tail instead of head regenerated from the posterior part bearing the graft, 68 days. Fig. 34, in the same transplantation as before the graft projects on the dorsal side, a, 20 days in lateral view; b, dorsal view of the grafted head, with 4 new eyes in 2 pairs beside 2 old ones.

of a head piece transplanted in reversed orientation, while figs. 33 and 34 are those in normal orientation. In two of these cases an outgrowth occurred on the ventral surface and a corresponding invagination on the dorsal. The graft head was then brought again into the same plane as the host body by the operation on both sides of the graft level, as indicated by broken lines in fig. 32 a, and the result as shown in fig. 32 b was obtained. Further, in the specimen of fig. 33 the anterior part was cut off at a level just behind the host pharynx, with the subsequent production of a tail in the reversed direction. Fig. 34 is the case in which the graft projected on the dorsal surface and two pairs of eyes were formed, one before and the other behind the graft pair (fig. 34 b). In the above cases, regardless of the orientation of the head graft, its influence on the host body was always the same, two pharynges in opposite direction being induced before and behind it.

Incomplete union: When union was incomplete and a part of the graft remained free, the latter grew up cylindrically accompanying the host tissue as
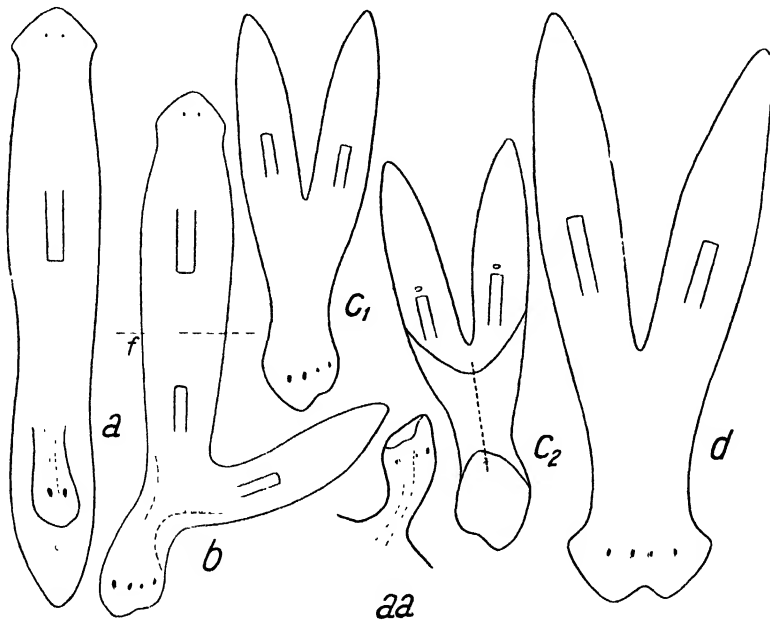
Fig. 35. Polarity reversal due to the transplantation of a head piece into the post-pharyngeal region in reversed orientation; a, dorsal view of the entire animal with the head graft grown-up cylindrically on the dorsal side, 28 days; aa, lateral view of the head alone; b, fission took place at the level of a broken line on 40th day; c, tail regenerated to the anterior side of the posterior part bearing the graft, 8 days after fission, c_1, dorsal and c_2, ventral view; d, after cutting open the cylindrical head on the ventral side, an animal with two heads and two tails resulted, 56 days from the beginning. Compare this figure with fig. 22 b.

in the cases of transplantation into the prepharyngeal region. A typical example of such a case is illustrated in fig. 35, a being a sketch of 28 day old specimen. In fig. 35 aa is represented the graft head with two supernumerary eyes of the same specimen, which is seen from the right side. After about 40 days from the first operation, fission took place at about the middle between the host pharynx and the induced one (indicated by a broken line in fig. 35 b), and a tail developed from the plane of fission (fig. 35 c_1). The ventral surface of the cylindrical head was cut open longitudinally at about the same time (c_2), and a worm with two heads and two tails appeared as shown in fig. 35 d.

To sum up the results of experiments so far as described of transplantations in *Planaria gonocephala*, a head piece, in whatever region of the body and in whatever orientation it may be grafted, always gives rise to a head. If the graft piece is united incompletely with the host body, heads from the normal to the extremely abnormal with transitional forms of various degrees can be formed; particularly, when the former is united merely with either the dorsal or the ventral epithelium of the latter, it develops into a funnel-like or a goblet-like head. And the portion connecting the graft and the host forms a cylindrical peduncle (the so-called postcephalic outgrowth of SANTOS). The peduncle is covered with the host epithelium of that side which is united with the graft. In these cases, though graft and host may unite with epithelia of different sorts, it can never happen that either the dorsal or the ventral epithelium takes over the character and the structure of the other, as already shown by L. V. MORGAN (1906) as well as by SANTOS (1931). This peculiarity of the epithelia may also be a cause for varying forms of the head produced according to different modes of union between the graft and the host.

If graft and host are united by epithelia of the same sort and a part of the graft is left free, it becomes the anterior end of the new head, no matter in what orientation and into what level of the host it may be grafted; and if the greater part of the graft is left free, the anterior end of the new head appears at the situation farthest from the point of union. Here accompanied with the change of axis in the piece, new eyes develop in relation to the new axis. Thus a close enquiry into the topographical relations between the old and the new eyes will readily reveal the course of development of the graft head.

The influence of the graft on the host is different according to the degree of union as well as according to the level of transplantation; so far as they are united by epithelia of the same sort, no matter on which one of the cut surfaces, anterior or posterior, right or left, the graft may unite with the host, always similar influence is exercised on the host. When union is complete, if a cut is made anterior to the graft, the graft develops into a head for the host body posterior to that level; and if a cut is made posterior to the graft, a head is formed in the reversed direction. In the latter case if the graft is transplanted in the postpharyngeal region, the development of a new pharynx is induced in front of the head. Here if the host tail is not

cut and left untouched, the development of two new pharynges, one anterior and the other posterior, is induced.

When the union is incomplete between the graft and the host, an outgrowth of a part of the latter is effected by an extension of the former, and a peduncle is formed. Here takes place scarcely any formation of new tissue. On the contrary, when the union is complete between the graft and the host, formation of new tissue always occurs, though different in quantity according to the level of transplantation. It is always between the new tissue of this sort and the old tissue of the host that a pharynx is formed in transplantation of a head piece into the postpharyngeal region. The new tissue is supposed to have been derived from the host by the influence of the graft; it represents a postcephalic region for the graft head and a prepharyngeal region for the host.

3.   Transplantation of the preocular piece

Transplantations were successful only in 5 cases, of which 4 were those into the prepharyngeal region and one that into the postpharyngeal region. But the results were almost identical. When a graft piece was transplanted into the prepharyngeal region and union was complete, if the host body anterior to it was removed, it always developed into a head (figs. 36, 37). In a case where union was incomplete owing to the lack of connection between the ventral epithelium of the graft and that of the host, the graft developed dorsally accompanying some of the host tissue into a funnel-shaped head, while another head regenerated from the cut surface (fig. 39).

In a case of postpharyngeal autoplastic transplantation, on removal of the host tail posterior to the graft piece, a head developed in the reversed direction as in the case of transplantation of a head piece. New tissue was formed along the line of union between the graft and the host, and a pharynx in reversed orientation was also induced at a level in front of the head (fig. 38). The new head was far smaller than the normal, though it was complete in morphology.
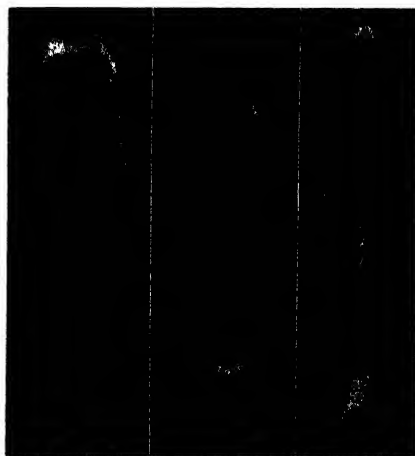
36   37   38

Figs. 36-37. Results of transplantation of a piece anterior to the ocular level into the prepharyngeal region and subsequent removal of the host part preceding it; a, homoplastic, 16 days; b, autoplastic, 17 days after the first operation.

Fig. 38. Transplanted into the postpharyngeal region and posterior part of the host removed, 23 days.

4. Transplantation of the auricular piece

All 3 cases that will be mentioned are autoplastic transplantation of the piece into the postpharyngeal region.   In the case of fig. 40 a, the host body posterior to the level of transplantation was removed, and the state of regeneration on the 7th day of operation is represented.   A complete head was formed after 63 days (fig. 40 b).   In the case of fig. 41, a tail regenerated from the cut surface of the host and in contact with the graft, while the graft itself developed likewise into a complete head and induced a pharynx in the outgrowth from the host.   In the third case represented in fig. 42, in contrast with the two preceding cases, neither eye nor pharynx was formed by the grafting.   But the part drawn out by the graft could never be considered to be provided with tail characters, and the tissue of this part could not be thought to have been assimilated by the host, since a small pore considered as a mouth appeared on the median line on the ventral surface.   But a pharynx was not formed after all.
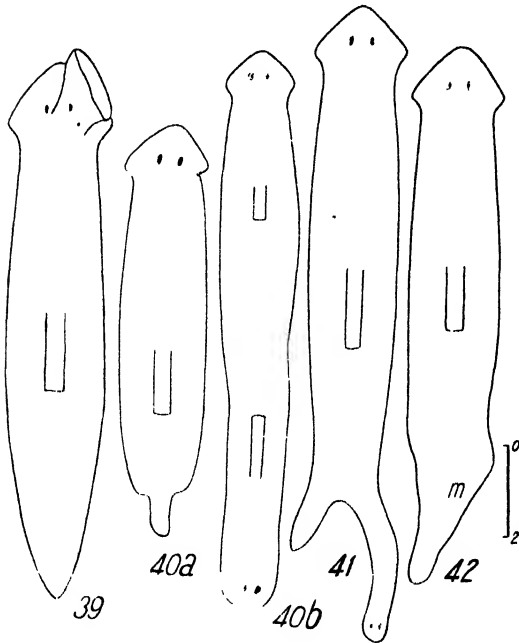
Fig. 39.   Incomplete union of a preocular graft with the prepharyngeal region.

Figs. 40-42.   Autoplastic transplantations of an auricular piece into the postpharyngeal region and subsequent removal of the host part posterior to it; fig. 40 a, 7 days; b, 63 days, during which anterior part of the host including the pharynx removed and regenerated.   Fig. 41, in a similar transplantation, tail regenerated besides head, 63 days.   Fig. 42, case in which neither head nor tail formed, but mouth (*m*) opens at the base of the elongated graft.

B. Prepharyngeal Grafts

In the middle of the part situated before the pharynx, a rectangular piece which was of approximately the same size as or somewhat larger than that which was employed in the experiments of head grafts was cut out (cf. fig. 1 a).   It was rotated anteroposteriorly in the same place or transplanted in normal or reversed orientation into the pre- or the postpharyngeal region of the same or another individual.   In this series of experiments also, the host body in most cases was cut after transplantation at a level anterior or posterior to the graft.

5. Rotation and transplantation in the same place

Rotation experiments were repeated 21 times. In 17 cases out of them the piece was placed in normal dorsoventral orientation and the union took place between the host and the graft on both dorsal and ventral sides by the respective epithelia. And up to 16 cases of this series of experiments the original head was cut off at a level anterior to the graft. As the result a normal head was regenerated in 13 cases, while in two of the remaining cases an abnormal head was formed and in the third regeneration was inhibited. In one specimen in which a secondary cut was not made, the rotated area was merely slightly elevated. The experiments and their results are summarized in table III.

Table III
Rotation of Small Area at Prepharyngeal Level.

Experiments			Results			
Mode of Implantation	Secondary Operation	Number	Regeneration of Normal Head	Regeneration of Hetero-morphic Head	Regenera-tion of Tail	Regenera-tion inhibited
Normal Dorso-ventral Orientation	Not performed	1				
	Cut anteriorly	16*	13	2		1
	Cut posteriorly	1			1	
Reversed Dorso-ventral Orientation	Cut anteriorly	3		2△		

* In one among these cases union was incomplete.
△ In one remaining case an indifferent form resulted.

In the cases where the rotated piece was brought into complete union with the main body, if the part anterior to it was removed, a head, notwithstanding the anteroposterior rotation of the piece, was always regenerated on the cut surface, i. e. the original posterior side. Fig. 43 represents a typical case. In these cases the new head was formed usually by the cooperation of the rotated piece and the tissue on both sides of it. In one case only the head was formed by the tissue solely of the small piece. Fig. 44 shows a case in which the worm was cut posteriorly to the rotated area. Here a tail regenerated on the cut surface, i. e. the original anterior side.

In the case of fig. 45 where union was incomplete, the posterior end of the rotated portion, i. e. the original anterior side did not come to be united with the main body. Hence a head regenerated therefrom and at the same time the head which had been removed regenerated. Generally speaking, rotated pieces can be united easily and completely; incomplete union, as in the case under consideration, is extremely rare, being met with only once during the whole course of our experiments. At any rate, it serves us sufficiently for a

demonstration that, if the original cut surface of the rotated piece is exposed, a head is regenerated therefrom.

Fig. 43. Result of the anteroposterior rotation of a small area in the middle of the prepharyngeal region (indicated by ×), followed by anterior cut, 16 days.
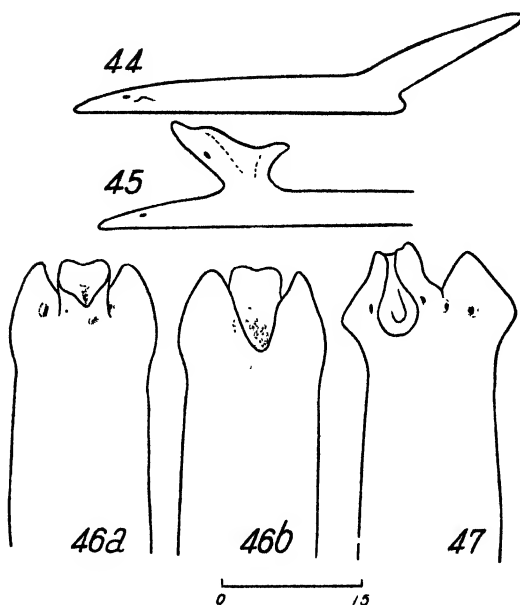
Fig. 44. Posterior removal to the rotated area in the prepharyngeal region, 23 days.

Fig. 45. Head regenerated in the rotated area of incomplete union, 32 days.

Figs. 46–47. Rotated area is dorsoventrally reversed; fig. 46, 71 days after the anterior removal, a, dorsal, b, ventral view. Fig. 47, 57 days.

Figs. 46 and 47 are the results of union of a rotated piece in reversed dorsoventral orientation with the main body, of which the head was subsequently removed. In these cases the reversed ventral epithelium formed an invagination, which became surrounded by the dorsal epithelium in cooperation with that of the main body. In the case of fig. 46, on each side of the rotated piece an incomplete head was formed, each provided with an eye, and on the dorsal epithelium surrounding the invagination of the reversed area, also, two small eyes were formed. In the case of fig. 47 also, the ventral epithelium of the reversed area formed an invagination. But, as the dorsal epithelium on migration became connected with the dorsal epithelium of the main body, the head developed from the graft (rotated piece) and the one regenerated from the left anterior cut surface of the host (main body) came, as it were, to embrace each other, the reversed ventral epithelium intervening between them, and, on the other hand, a more or less complete head developed from the right anterior end of the host. Further, the ventral epithelium of the reverted graft formed a narrow band-like portion and connected itself with the ventral epithelium of the host. As demonstrated by the two preceding cases, in replacement of the rotated piece

with their dorsiventrality reversed the graft never develops into a complete head in cooperation with the main body. This is due to the fact that the dorsal and the ventral epithelia are, as we have already seen, specialized to a considerable degree. By the way, it also depends on these differences of properties between the dorsal and the ventral epithelia that, when they are united, an outgrowth is always formed, of which the boundary is represented by the line of union.

As a control to the experiments of rotation, the prepharyngeal piece was transplanted with either normal or reversed orientation into a similar position of another worm. The results were literally the same as those in the preceding experiments, and on removal of the anterior part of the host body, further development gave rise to a worm identical with a normal one.

6. Transplantation of the prepharyngeal piece into the postpharyngeal region

The experiments and their results are summarized in table IV. In 9 out of 20 successful cases the graft piece was united in normal and in the remain-

Table IV

Transplantation of Prepharyngeal Piece into Postpharyngeal Region.

Experiments			Results			
Mode of Union	Secondary Operation	Number	Regeneration of Head	Induction of Pharynx		
				One	Two	None
Complete Union in Normal Orientation	Not performed	3			3	
	Cut posteriorly	4	3	4		
Complete Union in reversed Orientation	Not performed	4			3	1
	Cut anteriorly	3	3	3		
	Cut posteriorly	2	2	2		
Normal Orientation (Union at Anterior Cut Surface of Graft)		1	1 (From Posterior Cut Surface)			
Normal Orientation (Union at Posterior Cut Surface of Graft)		1	1 (From Anterior Cut Surface)			
Incomplete Union in Reversed Orientation		2	In both cases head was formed along line of union of two components			

ing cases, in reversed orientation. In the transplantation with normal orientation, if the host tail was cut off at a level posterior to the graft, a head developed from the cut surface (the original posterior end of the graft) (figs. 51, 52), with only one exception to the rule. Nevertheless, in this case too, a pharynx

developed in the reversed direction without any formation of the tail (fig. 53). There was also a case with the graft in reversed orientation, in which on removal of the anterior part of the host, a head was formed from the anterior cut
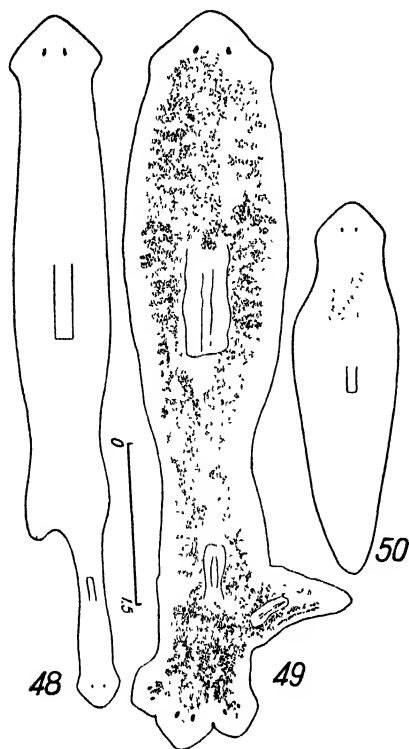
Figs. 48–49. Transplantations of a prepharyngeal piece into the postpharyngeal region in reversed orientation and subsequent removal of the posterior part of the host; in fig. 48 head regenerated to the posterior side and pharynx appeared in the new tissue, 21 days. Fig. 49. 3 heads are formed to the posterior or originally the anterior side of the transplant and tail to the right side from the posterior cut surface of the host, 60 days. Fig. 50. In the same transplantation as before, anterior part of the host removed; head regenerated to the anterior or originally the posterior side of the graft, 8 days after transverse cut.

Figs. 51–52. Transplantations of a prepharyngeal piece into the postpharyngeal region in normal orientation and removal of the host posterior part; fig. 51 a, showing the method of operation (grafting and subsequent cut); b, result of 40 days, head regenerated from the posterior cut surface which is also posterior to the graft. In fig. 52 tail regenerated in addition to the right side from the host 49 days.

surface, i. e. the original posterior end of the graft (fig. 50). In two other cases with incomplete union with the host, the graft migrated after the cut concurrently with the extension of the host tissue ; a new head developed from the line of union of the two components and a tail from the original posterior end of the graft.

There were 7 cases in which a cut was not made after transplantation. So far as the union was complete, no head was formed from the graft. Never-

theless, except in one case among them, two pharynges were induced, one anterior and the other posterior to the level of transplantation (figs. 54, 55, 57). In two other cases with incomplete union, a head developed in one and a tail in the other case. In the three remaining cases, after removal of the host tail a head was formed on the original anterior cut surface of the graft. Somewhat more precise explanations for individual cases will be given in the following lines.

In the cases of figs. 48 and 49 in which the graft was transplanted in reversed orientation with the subsequent removal of the host tail, one head in the former and three in the latter case developed from the posterior cut surface. In the case of fig. 48, a pharynx in reversed direction was formed in the new tissue induced by the graft; and in the case of fig. 49, a tail developed from the host tissue to the right of the cut, and a pharynx developed also in this tail, besides the one of the same significance as in the preceding case. In this specimen, moreover, three heads were formed, as mentioned, from the original anterior end of the graft in cooperation with the tissue at the posterior end of the host.

In the case of figs. 51 and 52, after a prepharyngeal piece was transplanted in normal orientation and the host tail was cut, a head was formed on the cut surface (the posterior end of the graft). In the case shown in fig. 53, a similar operation as in the two preceding cases was performed, and yet no head was regenerated from the graft. But the fact that a pharynx in reversed direction was induced suggests the possibility that the polarity of the tissue had been reversed.

Fig. 53. In the same operation as before, head regeneration inhibited but pharynx (*ph*) formed anterior to the graft in reversed direction, 20 days.

7. Development of pharynx induced by the transplantation of a prepharyngeal piece

As can be seen from the preceding cases, if a prepharyngeal piece be transplanted into the postpharyngeal level and if its end, anterior or posterior, be exposed for the second time by a subsequent cut, head regeneration always occurs regardless of the orientation of the graft, and the development of a pharynx is followed in approximately the same relation as in the transplantation of a head piece including the brain. That is to say, in those cases in which union is complete and no secondary cut is made, though no head develops from the graft and only an elevation instead is formed there, two pharynges in opposite directions are induced to develop anteriorly and posteriorly to

that level (figs. 54, 55, 56, 57). In the case of fig. 55, as the worm after transplantation of a prepharyngeal piece was divided into two by a cut just behind the host pharynx, the head at the anterior end was still small and regeneration of the pharynx also incomplete. Fig. 57 is a longitudinal section to show the elevation formed at the level of transplantation and the two pharynges induced. In fig. 58 is shown the photographic view of another specimen similar to the preceding. Fig. 56 represents a case in which the graft did not unite completely with the host and a portion of the former remained free, from which regeneration of a head was anticipated. But here, previous to the head formation, two pharynges already made their appearance, one anterior and the other posterior to that level. Examination of serial sections of the specimens of figs. 55 and 57 revealed, furthermore, no development of a structure at the level of the graft, which may correspond to or may, at least, be interpreted as a brain.

Figs. 54-56. Development of two pharynges, one anterior and other posterior, to a prepharyngeal graft in the postpharyngeal region; fig. 54, 23 days, from the mounted specimen. Fig. 55, in this example, the anterior part of the host is recently regenerated and the most anterior pharynx is shown far smaller than others which are induced, 54 days, from the mounted specimen. Fig. 56, in this case the left side of the graft left free and yet two pharynges are induced before head appears to the latter, 24 days; *tr* transplant.

Fig. 57. Median longitudinal section of a specimen bearing two pharynges, one anterior (*ph₁*) and other posterior (*ph₂*) to the prepharyngeal graft (*tr*) in the postpharyngeal region, 22 days; *H* head, *PH* old pharynx, *T* tail of host.

Thus the influence on the host of the prepharyngeal grafts transplanted into the postpharyngeal region is, though accompanied with no development of brain, nearly the same in quality as that of the head grafts. The only differences observed between the two cases are as follows. In the case of prepharyngeal graft, when union is complete no head is formed, and when union is incomplete a head is formed through the normal course of regeneration, whereas in the case of head graft the graft by itself develops into a head, etc. But the degree of the effect on the host exerted by the graft is so different between the two cases that it is clearly indicated by the distance between the level of transplantation and the induced pharynx. That is to say, the distance between the two is far greater in the case of head graft than in the case of prepharyngeal graft.

C. Pharyngeal Grafts

To what extent in the body of planarians, then, is distributed the potency which, when a piece from different levels of the body is transplanted into the heterotopic region, induces the development of pharynx? But instead of replying to this question directly, rectangular pieces were cut out from different levels of the pharyngeal region, i. e. just in front, at the base and in the middle of the region, and experiments which were similar to the preceding were carried out.

Fig. 58. Photographic representation of the same transplantation as before. Notice the high dorsal elevation at the grafted area, 40 days.

8.   Transplantation of the piece just before the pharynx

Transplantation into the prepharyngeal region: Union was complete in 10 out of 13 successful cases and incomplete in the remaining 3 cases. In 9 cases among the former, the graft was transplanted in normal orientation, direction of union being unknown in a remaining case. Pharynx developed in the graft in the 7 cases of complete union with normal orientation of the graft and in that case of unknown direction. One of these cases fig. 59 will be described as an example. By the operation new tissue was derived in a small quantity around the graft, and to the posterior of it, after 29 days, a mouth was observed to be open on the ventral surface between the graft and the new tissue. After still 28 days had passed, the worm was fixed and when cleared, a pharynx was detected well developed in the graft (fig. 59 *ph*). (In a specimen kept in water between 20-25°C. results similar to the above were reached in about 20 days). The new tissue which appeared around the graft was somewhat larger in quantity before the graft than behind it.

In the cases of incomplete union the results were complicated as shown in figs. 60–62. Thus in the case of fig. 60 in which the lateral surface of the graft united with the dorsal surface of the host, a small crescent-shaped

Fig. 59. Transplantation of a piece just before the pharynx into the prepharyngeal region; pharynx (ph) developed in the graft, 57 days.
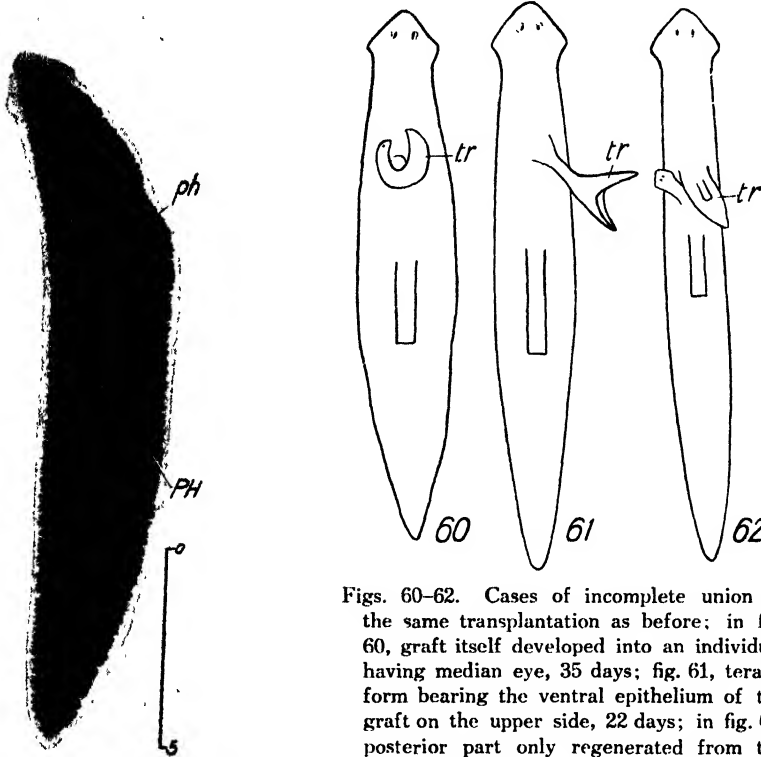
Figs. 60–62. Cases of incomplete union in the same transplantation as before; in fig. 60, graft itself developed into an individual having median eye, 35 days; fig. 61, teratoform bearing the ventral epithelium of the graft on the upper side, 22 days; in fig. 62, posterior part only regenerated from the graft, 10 days.

imperfect worm resulted, of which the head with a single eye was derived from the anterior and the tail from the posterior cut surface. In the specimen shown in fig. 61, the ventral epithelium of the graft was surrounded by dorsal epithelia of its own and of the host, and thus a horn-like project with a slender peduncle was formed. In the specimen of fig. 62, as the graft united merely by the anterior cut surface with the host and the lateral as well as the posterior cut surfaces were left free, a tail regenerated from the posterior end of the graft, with a pharynx in the graft itself. On the other hand, a head regenerated from the wound surface of the host.

Transplantation into the postpharyngeal region: Of 4 cases in which a piece similar to that used before was brought into the postpharyngeal region of another worm, the first example (fig. 63) represents a transplantation with reversed orientation of the graft. When, after operation, the host tail was

removed, the cut surface was healed over and neither head nor tail regenerated. Considerable elongation, however, took place at the level between the graft and the host. Afterwards fission of the worm occurred at the level indicated by a broken line in fig. 63 a. Still later when the head was about to be regenerated in the posterior partner of fission, a cut was made again through the graft that remained at the posterior end of the new worm, as shown by a broken line in fig. 63 b. As the result a normal head here developed with a pharynx anterior to it in the reversed direction (fig. 63 c). The polarity of this region had probably been reversed, though to a slight degree, by the first grafting. But the influence of such a degree had probably not sufficed either to cause a head to develop at the posterior end or to induce a pharynx.

In three other cases in which the graft was placed in normal orientation and no cut was made as the second operation, merely an elevation slightly above the host dorsal surface resulted at the level of transplantation. In one case, however, a pharynx was evidently formed in the graft (fig. 64).

9. Transplantation of the pharyngeal basis

Next followed transplantation of a small piece including the pharyngeal basis (cf. fig. 1 a, *ph.b*). Three successful cases were obtained in the prepharyngeal as well as in the post-pharyngeal region respectively.

Transplantation into the prepharyngeal region: In fig. 65 is represented a case with the graft in normal orientation, in which besides the pharynx that was transplanted (ph₁) one more pharynx developed in the graft (ph₂). In fig. 67 is indicated the result of transplantation in reversed orientation. No change was observed during 22 days after operation, except that a slight elevation was formed at the level of transplantation. Of course, there could not only take place no formation of extra pharynx as in the preceding case, but also the anterior branch of the host intestine kept away to the left from the grafted pharynx instead of connecting itself with it, as was revealed after the specimen was fixed and cleared.

Transplantation into the postpharyngeal region: When a pharyngeal piece, the same

Fig. 63. Transplantation of a piece immediately anterior to the pharynx into the postpharyngeal region in reversed orientation and removal of the posterior part of the host; a, ·60 days, fission took place at *f* level; b, 7 days later cut was made at *c* level and (c) head regenerated, 91 days from the beginning.

as in the preceding, was transplanted into the postpharyngeal region, a slight elevation was formed at that level, no further change, however, being observed either in the graft or in the host. But only in one case represented in fig. 68
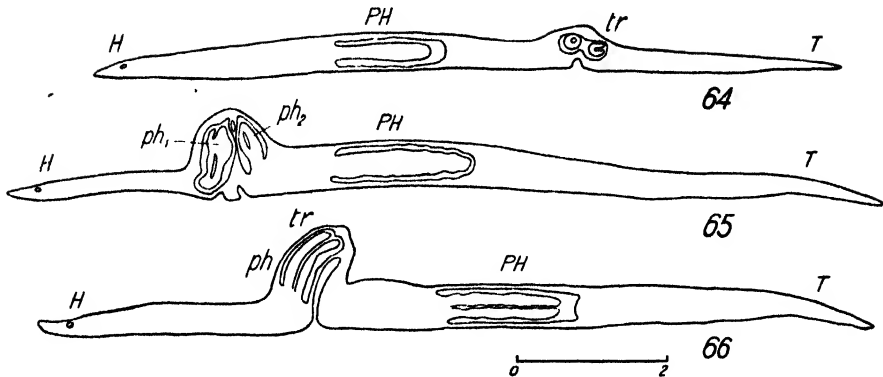
Fig. 64. Transplantation of the same piece as before into the postpharyngeal region, pharynx appeared in the graft (*tr*); Median longitudinal section of the fixed specimen, 23 days.

Fig. 65. Pharyngeal basis in the prepharyngeal region in normal orientation; extra pharynx (*ph₂*) developed in reversed direction besides the one (*ph₁*) regenerated in the graft.

Fig. 66. Piece from the midpharyngeal level in the prepharyngeal region in normal orientation; pharynx (*ph*) regenerated in the graft (*tr*); *H*, *PH*, *T* head, pharynx and tail of the host respectively.
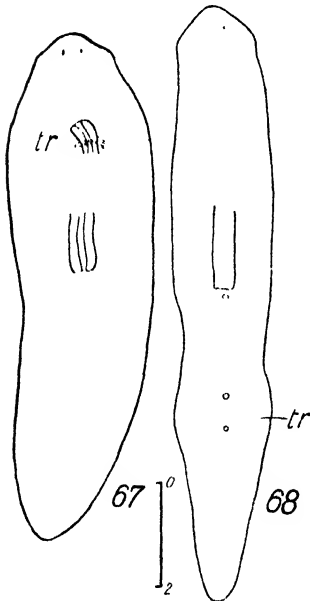
Fig. 67. Transplantation of a pharyngeal basis into the prepharyngeal region in reversed orientation; only one pharynx formed in the graft in reversed direction, 22 days.

Fig 68. Transplantation of a similar piece into the postpharyngeal region in reversed orientation; two mouths opened without formation of pharynx, 19 days, ventral view.

in which the piece was transplanted in reversed orientation, two mouth openings were found to have developed, one behind the other on the ventral surface of the graft.

10.   Transplantation of the midpharyngeal piece

Small rectangular pieces were cut out from the middle part of the pharynx (cf. fig. 1 a, *ph.m*) and transplanted into the pre- or the postpharyngeal region of another worm. The original pharynx came to fall off in these cases.

Transplantation into the prepharyngeal region: In all 4 successful cases, a dorsal elevation was formed at the level of transplantation with the development of a pharynx in the graft. One of these cases is illustrated in fig. 66 in which the graft was brought in normal orientation into complete union with the host and the new pharynx also developed in the normal anteroposterior direction.

Transplantation into the postpharyngeal region: Two successful cases were obtained. In each case a slight dorsal elevation was formed. But, after all, no pharynx developed.

Now, we compare the results of experiments above described of three sorts of transplantation, i. e. those of pieces from just before the pharynx, from the pharyngeal base and from the middle part of the pharynx.   When a piece just anterior to the pharynx is brought into the pre- or the postpharyngeal region, much tendency is still indicated in the graft towards induction of the pharynx.   That the pharynx is induced to develop through the graft derived from the pharyngeal base may rather be regarded as a natural course of events, since in such pieces are included, from the outset, those tissues from which regeneration of the pharynx ought to occur.   In one of the cases under consideration with the graft in the prepharyngeal region, besides the pharynx regenerated in the graft, another pharynx developed in the reversed direction (fig. 65).   The development of this pharynx (ph_2) is considered to be due to the induction that took place in that part of the host prepharyngeal region which was situated posteriorly to the graft level (and which, viewed from the point of differentiation, must be regarded as more anterior at level than the graft tissue).   But when a similar piece is brought to a level posterior to the pharynx, formation of a pharynx does not follow, except that a mouth opening is formed on the host ventral surface.   More conspicuous are the differences when pieces from the middle part of the pharynx are brought to different levels.   If such a piece is transplanted into the host prepharyngeal region, a pharynx always develops in the graft.   But if it is transplanted into the postpharyngeal region, no pharynx and even no mouth opening result.

From the data above presented, it may be concluded that the piece just before the pharynx has a potency to give rise to a pharynx independently, regardless of the level of transplantation, that the piece from the pharyngeal base, if not under the influence of the host, can not proceed further in the induction of a pharynx than the formation of a mouth opening, and that the piece from the middle part of the pharynx is destined in the future to be wholly under the influence of the level of grafting.

D. Postpharyngeal Grafts

Grafts which were used in this series of experiments were small rectangular pieces cut out from the middle of the postpharyngeal region or somewhat more posteriorly (cf. fig. 1 a).

11. Transplantation of the postpharyngeal piece into the prepharyngeal region

Transplantations were successful in 17 cases in all, among which grafts were in normal orientation in 5 cases, at right angles to the host in one case, in reversed orientation in 10 cases, and united obliquely with the host in one case respectively.   The results depend in these cases rather on the varying degrees of union between the graft and the host (cf. Table V).

Table V
Transplantation of Postpharyngeal Piece into Prepharyngeal Region.

Experiments			Results				
Mode of Union	Secondary Operation	Number	Regeneration of Head	Regeneration of Tail	Saccular Projection	Small Worm	Abnormal Forms
Complete Union in Normal Orientation	Not performed	2			2 (Pharynx developed)		
	Cut anteriorly	1	1				
Complete Union in Reversed Orientation	Not performed	1			1 (Pharynx developed)		
	Cut anteriorly	3		3			
	Cut posteriorly	2		2			
Incomplete Union in Normal Orientation		2				1	1
At Right Angles and Obliquely		2				2	
Incomplete Union in Reversed Orientation	Not performed	1					1
	Cut posteriorly	3	1				2

In general when these transplantation complexes are cut at a level anterior or posterior to the graft, a head regenerates from the anterior and a tail from the posterior cut surface in accordance with the polarity of the graft. In the cases where union is incomplete, both the head and the tail are regenerated from the graft itself and an independent worm body is formed,
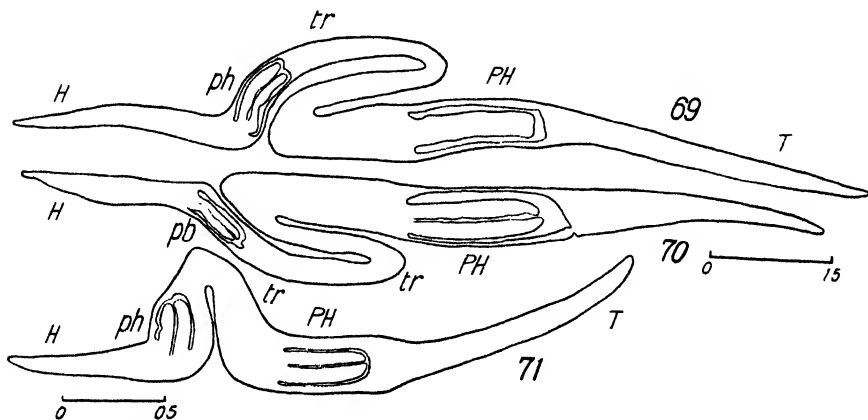
Figs. 69–71. Median longitudinal sections of the specimens obtained by the prepharyngeal transplantation of a postpharyngeal piece; fig. 69, in normal orientation, the graft projected on the dorsal side, 21 days. Fig. 70, similar specimen with the ventral projection, 21 days. Fig. 71, graft placed in reversed orientation, 90 days. *H, PH, T* head, pharynx and tail of the host, *ph* pharynx developed in the graft, *tr* graft.

though nourishment is taken from the host (cf. figs. 76, 77, 78). So far as the anterior side of the graft is in complete union with the host, a tail always regenerates from the posterior side that remains free, no exceptional case with head development being observed.

Cases in which union is complete: If a cut was not made after union, a prominent projection was formed at the level of transplantation either on the dorsal or the ventral surface, with a corresponding deep invagination on the ventral or the dorsal surface. Moreover, a pharynx always developed in the projection at the boundary between the graft and the anterior part of the host. In fig. 69 is represented a specimen with a dorsal projection, while in fig. 70 one with a ventral projection.

In the cases where the graft was placed in normal orientation, when a cut was made on the host body at a level just anterior to the graft and the anterior cut surface of the latter was exposed for the second time, a head developed therefrom and took command of the body posterior to it.

Fig. 71 represents a case with the graft transplanted in reversed orientation, the result being the same as in the case of fig. 69 with the graft in normal orientation. In the cases represented in figs. 72 and 73, the anterior part of the host was removed in the same transplantation as before. In either case the graft extended itself considerably forwards and a mouth was opened at the position indicated in the figure by a small circle of dotted line. Undoubtedly it was a
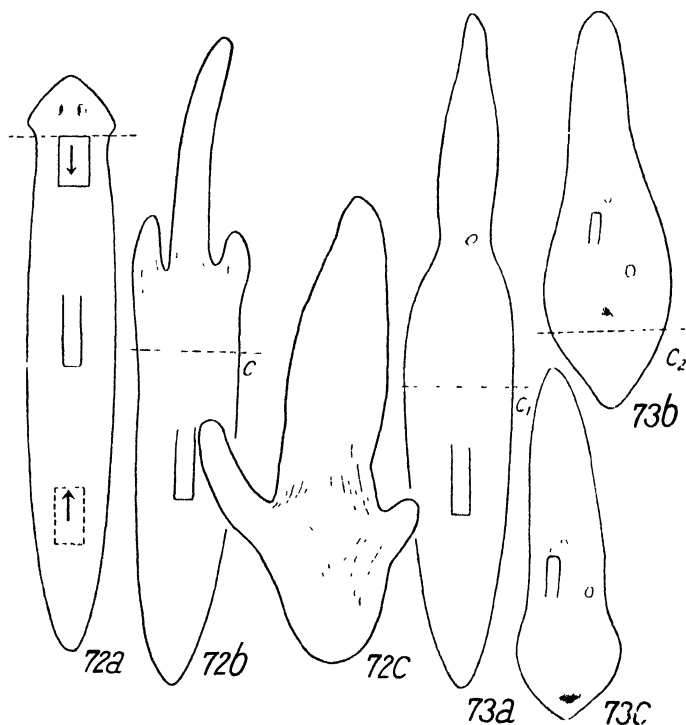
Figs. 72–73. Transplantations of a postpharyngeal piece into the prepharyngeal region in reversed orientation and removal of the anterior part of the host, fig. 72 a, showing the method of experiment; fig. 72 b, result after 16 days, posterior part of the host removed at c level; c, anterior piece at 38 days later. Fig. 73 a, another example of the same transplantation and operation as before at 24 days; when cut was made at c_1 level; b, anterior part, 21 days later the posterior part again removed at c_2 level; c, 57 days from the beginning.

tail that was regenerated.   In the case of fig. 72, small extensions directed for-
wards of the host tissue appeared on both sides of the graft, no head, however,
being formed on either side.   In the case shown in fig. 73, no such side projec-
tions were formed from the host.   In these two cases, when the host body was
cut at the level indicated by a transverse dotted line in fig. 72 b and 73 a, tail
regeneration was inhibited at the posterior end of the anterior part of the host
bearing the graft, and a small pharynx in reversed direction developed in
the new tissue which had grown from the graft.   In the case of fig. 73, be-
sides the mouth situated towards the pharynx, another mouth opened on the
median line (fig. 73 b).   Later on, when this specimen was cut once more at
the level shown by a dotted line in fig. 73 b, the posterior cut surface was
again healed over and no regeneration occurred (fig. 73 c).   Worms of such
forms finally reached the state as shown in figs. 72 c and 73 c, and stood still
without any movement so long as no stimulus was given.   But, if pricked by
the point of a hair-pencil, they moved in a direction opposite to the original
polarity of the main body.   The specimen represented in fig. 72 c, though
possessed of a pharynx of unknown direction near its posterior end, showed no
reaction towards food, whereas the one represented in fig. 73 c could draw
near to and take it (hen's liver).
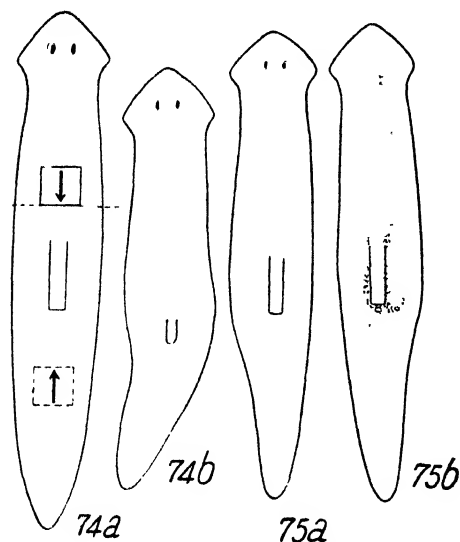
Figs. 74-75.   In the same transplantations as
before posterior part of the host removed, fig.
74 a, showing the method of experiment; b,
result after 13 days.   Fig 75, another example
of the same experiment at 42 days, a dorsal,
b ventral view.

In similar experiments with the
graft in reversed orientation, when
the posterior part of the host
behind the graft was removed, a
tail regenerated on the cut surface
(figs. 74 and 75).   In the speci-
men of fig. 75 two mouths were
formed.

*Cases in which union is in-
complete:*   Figs. 76, 77 and 78
represent cases, in every one of
which as union was incomplete, a
head and a tail regenerated re-
spectively at the anterior and the
posterior end of the graft, a pha-
rynx, moreover, formed between
the two, and thus an independent
worm resulted.   In the case of fig.
76, a lateral twin was formed owing
to the lateral union.   In the case
of fig. 77, the individual which has
grown from the graft was united
with the host by its dorsal surface,

and thus a dorsal twin was formed.   In the case of fig. 78, the graft was
brought into union with the host, the lateral surface of the former being united
at right angles with the dorsal surface of the latter, and the composite body

grew into a cross twin. The intestine of the graft was, in every case, in connection with that of the host and the food taken by the latter passed directly into the intestine of the former.   But the body grown from the graft was also able to take food by itself.
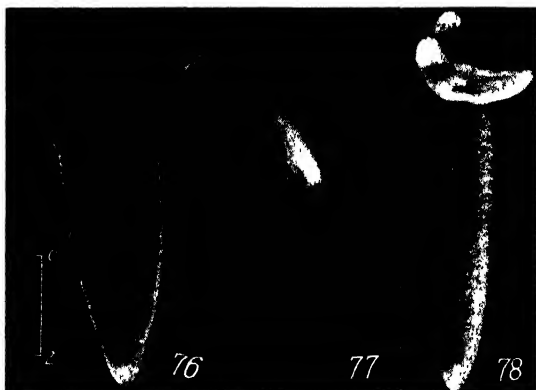
Figs. 76–78 a. Three cases of incomplete union of the postpharyngeal graft with the host in the prepharyngeal region, each developing to a complete animal; fig. 76, lateral twin, 38 days; fig. 77, dorsal swin, 24 days; fig. 78 a, cross twin, 12 days.

Figs. 78 b–79. Incomplete unions of the graft (continuation to preceding cases); fig. 78 b, the same specimen as before in outline, drawn from the living specimen. Fig. 79, specimen with two heads, one (right) regenerated from the host, other (left) developed from the graft, 55 days.

Since the posterior cut surface of the graft in the case of fig. 79 united almost completely with the host, no tail was formed by the graft itself. Meanwhile, a head and the following regions were formed from the anterior cut surface that remained free. A common tail, on the other hand, regenerated on removal of the posterior part of the host.

Now, in those cases in which both dorsal and ventral epithelia of the graft united merely with the dorsal epithelium of the host, the graft piece extended considerably outwards and developed into a queer shape provided unexceptionally with a long peduncle. In fig. 80 is given such an example. Forms which are similar to this were often met with also in those cases in which other regions were employed as grafts. But they were rarely provided with such a long peduncle.

12.   Rotation of a small area with concurrent transplantation in the same position

A small rectangular area in the middle of the postpharyngeal region was rotated anteroposteriorly in 11 cases.   In 4 cases among these the anterior part of the host was removed by a cut along the posterior margin of the graft, in 5 other cases the host tail region was cut off along the graft anterior

margin, and in the remaining 2 cases, one complete and the other incomplete union, no cut was made. In one of the last mentioned where union was complete, no further change was observed than widening of the host body at the level of replantation. But in the other specimen, as the original anterior cut surface of the rotated area had not been brought into union with the host tissue, a head regenerated therefrom and two pharynges in opposite directions developed, one before and the other behind it. Furthermore, 3 experiments were made for the sake of comparison, besides those which were above described, with the graft transplanted in reversed orientation into the same position of another individual. In 2 cases among these, which were not accompanied with secondary amputation, no changes were observed. The experiments and their results are summarized in table VI.

Complete union: In 4 cases the anterior part of the main body was removed, the rotated area being left behind. In only one case among these a head developed at the new anterior end. In each of the 3 remaining cases a tail regenerated. In the case of fig. 81, fission occurred previous to the amputation, i. e. on the 15th day after operation, and a tail regenerated at the anterior as well as the posterior end of the part bearing the rotated piece. In this case the right anterior cut surface grew outwards to form a projection, at the base of which a pharynx (*ph*) was formed. But no head developed after all on the projection. A side projection appeared also in a homo-

Fig. 80. Sack-like projection as the result of transplantation of a postpharyngeal graft into the prepharyngeal region, both dorsal and ventral epithelia uniting with the host dorsal epithelium only, 33 days.

Table VI

Rotation of a Small Area in the Postpharyngeal Region.

Experiments			Results		
Mode of Union	Secondary Operation	Number	Regeneration of Head	Regeneration of Tail	No Change
Complete	Not performed	1			1
	Cut anteriorly	4	1 (Polarity reversal occurred in the rotated body)	3	
	Cut posteriorly	5	2	3 (Polarity reversal occurred in the rotated body)	
Incomplete	Not performed	1	1 (Two pharynges appeared)		
Complete* Union	Not performed	2			2
	Cut anteriorly	1		1	

* Transplantation experiments for comparison.

plastic transplantation shown in fig. 83, but no pharynx was ever formed. In the case of fig. 82, a head regenerated from the left side of the main body near the base of the tail which had developed anteriorly from the rotated
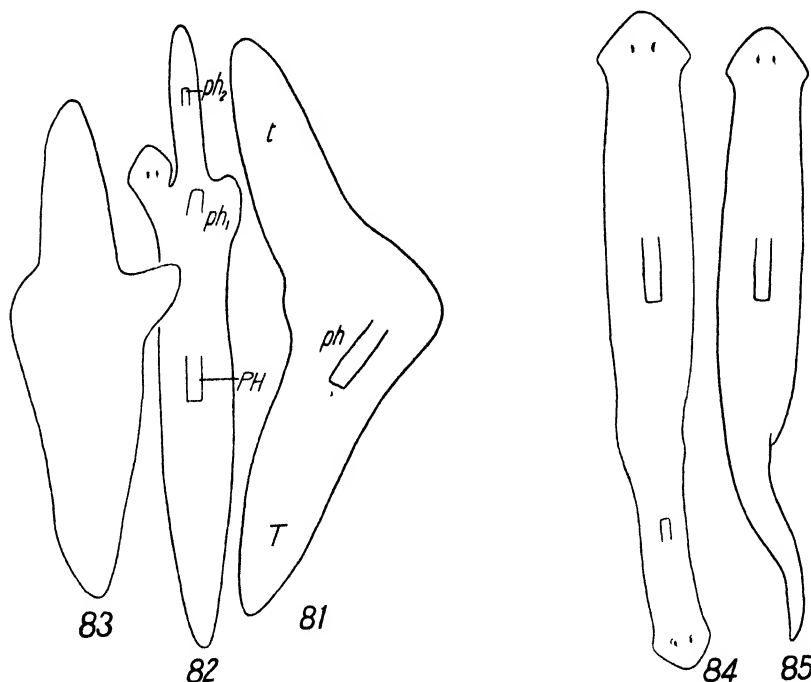
Figs. 81-82. Results of anteroposterior rotation of a small area in the postpharyngeal region and subsequent removal of the more anterior part; fig. 81, 25 days, before this period the posterior greater part was lost due to fission and regeneration occurred. Fig. 82, head regenerated from the host to the left side of the tail developed from the rotated area, in the latter appeared two pharynges in the same direction, 23 days. Fig. 83. As control to the preceding experiment, piece of another individual was transplanted to the corresponding level and the anterior part of the host removed, 49 days, ventral view.

Figs. 84-85. In the same experiments of anteroposterior rotation in the middle of the postpharyngeal region, the part posterior to the rotated area removed; in fig. 84 head produced, 38 days; in fig. 85 tail produced, 37 days.

area. A normal pharynx (*PH*) was induced thereby in the main body. Besides, two more pharynges opposite in direction to the preceding developed, one (*ph₁*) at the level of union between the rotated area and the main body and the other (*ph₂*) in the new tissue of the anterior tail.

Those heteropolar tails which were found in the preceding cases were formed, needless to say, through the growth of the grafts themselves.

Fig. 84 represents a case in which on removal of the tail region posterior to the rotated area, a head regenerated to the posterior side, i. e. on the anterior cut surface of the rotated piece. Fig. 85 shows a similar case in

which, however, a tail developed. In such cases as the former, the second pharynx was always formed in that portion which had grown from the rotated piece.

Polarity reversal : Polarity reversal was observed in one case to have been induced in the neighbouring tissues of the main body through the rotation of the postpharyngeal area. It is indicated in figs. 86 and 87. A few days after amputation of the worm in front of the rotated area, fission occurred in the main body (fig. 86). A tail was formed at the anterior end of the anterior partner bearing the rotated piece, i.e. on the original posterior cut surface of the piece (b), as it was well expected, and at the same time a head regenerated on the posterior wound surface that had been produced through the fission of the worm. An eye on one side (fig. 86 c) appeared first and another on the other side followed, proving beyond doubt that it was a head that was regenerated posteriorly. Meanwhile, at the level of union of the two tissues of opposite polarity a pharynx developed with normal direction to the new head. On the other hand, from the tissue on both sides of the rotated area projections were formed, which grew in length as days passed (fig. 86 c), but began to be absorbed as the worm body increased in size (fig. 87 a). The posterior partner which had arisen from the fission above noted developed, as a matter of course, into a normal worm with a head developed at the anterior end (fig. 87 b).

Incomplete union : In these cases of rotation of a small area, if the anterior cut surface was not brought into union with the main body, a head developed therefrom. Regardless of its shape, its influence on the latter was the same as in the transplantation of a head piece in that it induced two pharynges with opposite direction, one before and the other behind it.

As may be seen from the above examples of transplantation and rotation, a

Fig. 86. Polarity reversal in the part posterior to the rotation in the postpharyngeal region; a, 5 days after removal of the anterior part, when fission took place; b, anterior part of fission, 12 days; c, 14 days, head with one eye regenerated to the posterior side.

Fig. 87. Continuation of the preceding figure. Anterior (a) and posterior part (b) of fission in fig. 86 a at 24 days.

small piece which is taken from the post-pharyngeal region shows, when grafted, a strong tendency to regenerate a head from its anterior and a tail from its posterior cut surface. But according to the level of transplantation or to the mode of union with the host, this property does not necessarily come to be manifested. In addition, it may be worth noticing that the graft taken from the postpharyngeal region is able to develop independently. In this respect the transplantation of a postpharyngeal piece is much different from that of a head or a prepharyngeal piece.
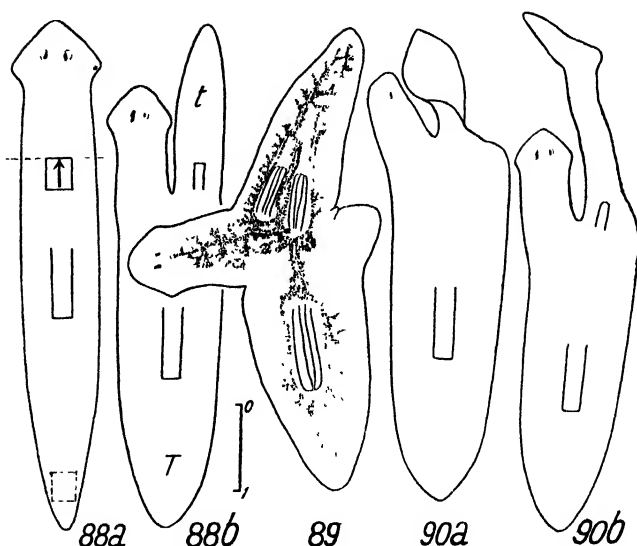
Figs. 88–90. Transplantations of a tail piece into the prepharyngeal region in normal orientation and removal of the anterior part of the host, fig. 88 a, showing the method of operation, b, result at 22nd day; tail developed from the graft and head regenerated from the host on the left side, pharynx appeared in the new tail in reversed direction. Fig. 89, in a similar example two pharynges developed at the base of the anterior tail in reversed direction, 71 days. In fig. 90 the graft dorsoventrally reversed, a, 10 days, and b, 23 days.

E.   Tail Grafts

13.   Transplantation of the tail piece into the prepharyngeal region

As the tail grafts were used pieces which were of a rectangular form as usual and were cut out as near as possible from the posterior end of the worm (cf. fig. 1 a, *t*). Transplantation of the pieces into the host prepharyngeal region was successful in 6 cases, being placed in normal orientation in all these cases except one.

Cases in which union is complete: In the cases where a tail piece is transplanted in normal orientation with subsequent removal of the host head, a tail develops from the cut surface, i. e. at the original anterior end of the piece, as may be seen in figs. 88, 89 etc. In the case of fig. 88, a head was regenerated from the left anterior angle of the host and a pharynx with reversed direction developed at the base of the tail which had already grown to a full extent from the graft (fig. 88 b). In the case of fig. 89 also, a head regenerated from the host much the same as in the preceding. But through the existence of the tail which had developed from the graft and attained a con-

siderable size, the head was turned towards the direction at right angles to the main axis of the body.   Although a projection had also been formed to the right from the anterior cut surface of the host, it could not develop into a head.

In this specimen, furthermore, two parallel pharynges developed in the opposite direction. (The one on the right preceded the other, which did not appear until the regenerated head grew larger).

Fig. 90 represents a case with the graft in reversed dorsoventral orientation, in which also a head was regenerated from the cut surface on the left side of the host. The graft extended itself in an irregular form and gradually turned itself over, until normal dorsoventral orientation was reached (fig. 90 b).

In the two following cases, the graft was too small for the anterior and the posterior cut surfaces

Figs. 91-93. Incomplete unions of a tail piece; fig. 91, anterior part of the host romoved after the piece united, anterior and posterior sides being free, with the host prepharyngeal region in normal orientation, 10 days when the anterior elongated part of the graft and two lateral processes of the host cut removed; b, 38 days, tail formed on the graft with two pharynges in reversed orientation and head regenerated from the right stump of the host. Fig. 92, graft dropped off next day when anterior part of the host removed, and yet a perfect tail developed to the anterior side, 52 days. Fig. 93, the graft dorsoventrally reversed; a, 16 days, exceedingly elongated graft turned backwards on the host dorsal side; b, graft cut isolated with the host head, 142 days.

to be united with the host, so that only the lateral cut surfaces were united. In the case of fig. 91, after the anterior part of the host was cut off, regeneration took place in the graft, which soon resulted, however, in the healing over of the anterior end. Regeneration occurred also on the cut surfaces on both lateral sides of the host and after about 10 days an eye was formed on the left regenerate (fig. 91 a). The anterior end of the graft and the regenerates on both sides were then cut off as indicated in the figure by broken lines. After 4 days a distinct tail developed on the anterior cut surface of the graft, and at the same time two pharynges with reversed orientation made their appearance (fig. 91 b). Thereafter a head developed from the cut surface on the right of the host.   As it grew larger, it turned in a direction at right

angles to the entire complex. In the case of fig. 92, the graft fell off from the host on removal of the host anterior part. But a part of the new tissue which had already formed by that time grew into a tail, in which a pharynx with reversed direction was formed.

Cases in which union is incomplete: In another case with incomplete union (fig. 93), only the anterior cut surface of the graft was united with the dorsal surface of the host. As the graft developed it fell backwards giving rise to a tail with reversed dorsoventral orientation. When the head region of the host was removed, a new head was regenerated (fig. 93 a). Then (on the 16th day after the first operation) the host head in connection with the graft was separated from the rest of the body at a level indicated by a broken line. A worm resulted with the head of the host at the anterior end (fig. 93 b).

As demonstrated in the preceding experiments, a tail piece when brought into the other places always develops into a tail regardless of its orientation at the time of transplantation, i. e. regardless of its original polarity. And a pharynx is formed in the graft, more precisely in the new tissue which has grown from the graft. If a head is regenerated from the host in the neighbourhood of the graft, development of the eye on that side which is near to the graft is retarded by the invasion of tissue from the graft (cf. figs. 88, 90 etc.). That development of the pharynx is not necessarily due to induction by a head which is regenerated is indicated by such a case as shown in fig. 92.

14 (F). Rotation of a small area in the front of the posterior part immediately after fission

A small rectangular area was chosen in a comparatively anterior part of the posterior partner which had resulted from fission, and it was rotated anteroposteriorly. After reunion a cut was made at a level anterior to the rotated area. In the first case (fig. 94), after removal of the region anterior to the rotated area, a head regenerated. Several days passed before the second removal of the anterior part was executed, which was followed again by regeneration of a head. Meanwhile, from the anterior end on the right of the rotated area a slight dorsal swelling appeared, which gradually extended backwards (fig. 94 a). Through prolonged observations during which this projection was taken as a landmark, it was revealed that the rotated tissue between the head end and the posterior end of the projection was considerably elongated (fig. 94 b).

In the second case, operation was postponed until a little time had elapsed after fission and regeneration of a head took place at the anterior end, two eyes making their appearance. Here, on removal of the anterior part of the worm, a tail regenerated from the cut surface of the rotated area and extended forwards and to the left, while the anterior cut surface of the host which had been healed over extended forwards and to the right of the composite (fig. 95 a). Meanwhile, the posterior part of the worm was lost through fission and a new tail was regenerated (fig. 95 c). Then, the projection on the right side was

again cut at a level indicated by a broken line in fig. 95 c, but here also no head was regenerated. Instead, a pharynx was formed in the rotated area (fig. 95 d).

In the third case also, the worm was operated upon almost at the same stage as in the preceding case (fig. 96). In this case both the dorsal and the ventral epithelia of the rotated area were united with the dorsal epithelium of the main part. Moreover, the graft stood at right angles to the host, the ventral surface of the former having been directed forwards and the dorsal backwards. When union occurred in such a manner, the anterior part of the composite was removed. From the posterior end of the rotated area that remained free (*fr.e*) a tail developed and extended itself at right angles to the main body, while the ventral epithelium at the anterior end of the former extended itself forwards, dividing, as it were, the dorsal epithelium of the latter into two lateral halves (fig. 96 a_1). Two eyes appeared on each

Figs. 94–95. Anteroposterior rotations of a small part in the front of the posterior part of fission (originally postpharyngeal region); fig. 94 a, 12 days after removal of the part anterior to the rotated area, head formed; b, 25 days. Fig. 95 a; 7 days after anterior removal in another specimen, fission took place; b, anterior part of fission, 14 days; c, 20 days, second removal of the anterior part grown from the host tissue was executed at c level; d, 40 days from the beginning, head formation inhibited to the end but pharynx appeared in normal direction.

side of the host dorsal epithelium. On the 21st day from the first operation, the old tail was cut off at the level indicated by a broken line in fig. 96 b. As the worm was possessed, on its dorsal side also, of the ventral epithelium developed from the graft, it soon turned itself over and could glide over the bottom of a vessel with the ventral side of the graft (fig. 96 c_1). Then, regeneration was checked at the cut end of the old tail that was apart

from the bottom of the vessel, but a black spot appeared in this portion. Whether it was an eye or not could not be ascertained. Further, only a single pharynx developed in the worm, and corresponding to it a mouth opened not only on the ventral side of the host, but also on the dorsal side which was lined with the ventral epithelium derived from the graft.

Although in the above experiments rotation of the small area was made in an anterior region of the posterior fission-body, the results were approximately the same as in those experiments executed in the postpharyngeal region of the normal worms. This fact may prob-

Fig. 96. Incomplete union of the rotated piece, free end (fr.e) being posterior, with the main part of the body; a_1, 7 days after the anterior removal, dorsal, a_2, lateral view; b_1, 20 days, dorsal, b_2, lateral view, posterior part of the host removed at c level; c_1, 24 days, dorsal, c_2, ventral view, tail regeneration inhibited.

ably be explained by the supposition that the anterior region of the posterior fission-body at a time immediately after separation is not yet fully differentiated and preserves still much of the original properties of the postpharyngeal region.

15 (G). Double transplantation to the anterior and posterior sides

The following mode of transplantation was successful in only one among many trials. A small piece taken from the postpharyngeal region of a worm was transplanted into the prepharyngeal region of another worm, and at the same time a head piece of the former into the postpharyngeal region of the latter.

Here, the postpharyngeal piece was made to be united with the host in normal dorsoventral and reversed anteroposterior orientation, while the head piece in reversed dorsoventral and normal anteroposterior orientation. When, thereafter, the head and tail regions of the host were cut off before and behind the grafts, a tail developed at the anterior and a head at the posterior

end in the same way as in the foregoing experiments with a single graft (fig. 97 a₁, a₂). Further, when after 61 days the graft head was removed, a head was regenerated, and a pharynx (ph_1) with reversed direction was induced immediately behind the old pharynx (PH) of the host (fig. 96 b). Moreover, in the tail developed from the graft also, a pharynx (ph_2) with reversed direction was similarly formed. The worm took food and enlarged. When stimulated, it moved towards the direction of the head, though the polarity of that part derived from the host remained evidently unchanged. On the 128th day after the first operation the worm was divided into three at the levels indicated by broken lines in fig. 97 b, thus isolating again the host part in the middle from other parts. The results were as follows. As to the anterior part of the worm provided with the tail, a head was produced from the cut surface, and as to the posterior part including the head, a tail was formed from the cut surface; these parts developed each into a perfect individual (fig. 97 c₁, c₃). Meanwhile, as regards the middle part which represented the original tissue of the host, the anterior cut surface was healed over and from the posterior cut surface alone a tail was regenerated (fig. 97 c₂). The anterior cut surface which had been healed over was again cut, but no regeneration took place as before. Yet, this imperfect regenerate, when stimulated, moved slowly forwards,
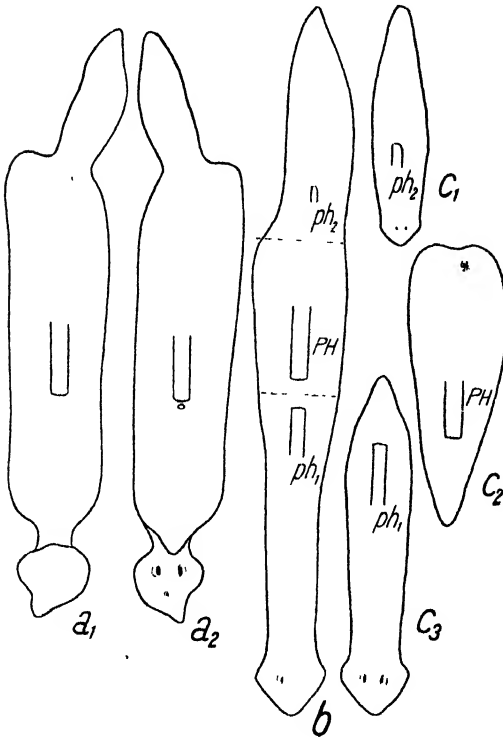
Fig. 97. Double transplantation of a postpharyngeal piece to the anterior side of the prepharyngeal region in reversed orientation and a head piece to the posterior side of the postpharyngeal region in normal but dorsoventrally reversed orientation; a₁, 13 days after anterior and posterior parts of the host removed, dorsal, a₂, ventral view, b, again the grafted head removed, 100 days in dorsal view. On 128th day the specimen was cut into three parts; c₁, the anterior part originated from the postpharyngeal graft, c₂, the host, c₃, the posterior part with the head graft on the posterior side, 143 days.

proving that the original polarity was still preserved. This body under consideration did not take food and accordingly became weaker and smaller, exhibiting no further change during 43 days after it was isolated.

II. Union of Large Pieces

In the above category of experiments in which a small piece from one region of the planarians is transplanted into other regions of the body, so far as the graft is united completely with the host, new tissue always arises between two components, the quantity of which increases in proportion with the topographical difference preexisting, i.e. the distance originally presented between the graft and the host. It is also known from the results of experiments that considerable differences in behavior are manifested between a graft from the head region and one from more posterior regions, especially from the postpharyngeal region. In the case of the former the graft, instead of growing by itself, induces the growth of the host tissue, while in the case of the latter the graft grows by itself. And if it is the postpharyngeal region that is induced to grow, a pharynx develops in the new tissue. On the other hand, when a head or a prepharyngeal piece is transplanted into the postpharyngeal region, it directly reorganizes the tissue of that part and induces the formation of a pharynx.

Then, in the next place two large pieces cut out from different levels of the worm are united in various orientations, and in the light of these experiments the results of the preceding experiments with small pieces are criticized, especially for the formation of new tissue on the plane of union and the mutual influence of the pieces united.

16. Union of pre- and postpharyngeal regions in normal orientation

The body of a planarian being separated into three by the cuts before and behind the pharynx, the anterior and posterior parts were next brought to be united by their cut surfaces. Between two components new tissue appeared in a large quantity, and a pharynx developed in it. In fig. 98 a are represented the parts to be united (*ap* and *pp*), in b the mode of union and in c the final result. This experiment of median substruction was already conducted also by Li (1928) with the same results as the above, except that he did not report whether a pharynx developed or not.

17. Union of pre- and postpharyngeal regions in reversed orientation

A prepharyngeal piece from which the head had been removed was united in reversed orientation with the postpharyngeal piece, i. e. the anterior cut surface of the former was brought into connection with the same of the latter as indicated in fig. 99 b. As the result new tissue was also formed along the line of union, and in the new tissue or at its boundary with the old tissue of the postpharyngeal piece a pharynx was produced. Further, a tail was regenerated at the original posterior end of the prepharyngeal piece, and here a pharynx was formed in the same way as in the ordinary cases. Five cases which were accompanied with such results were obtained. In the case of fig. 99 c, two parallel pharynges were formed in the new tissue. In the case represented in

fig. 100, projections without any differentiation appeared on both sides of the position where union of two pieces took place. On the 22nd day after union, a cut was made in this specimen in such a way that a part of the prepharyngeal piece remained in connection with the postpharyngeal piece. From the anterior
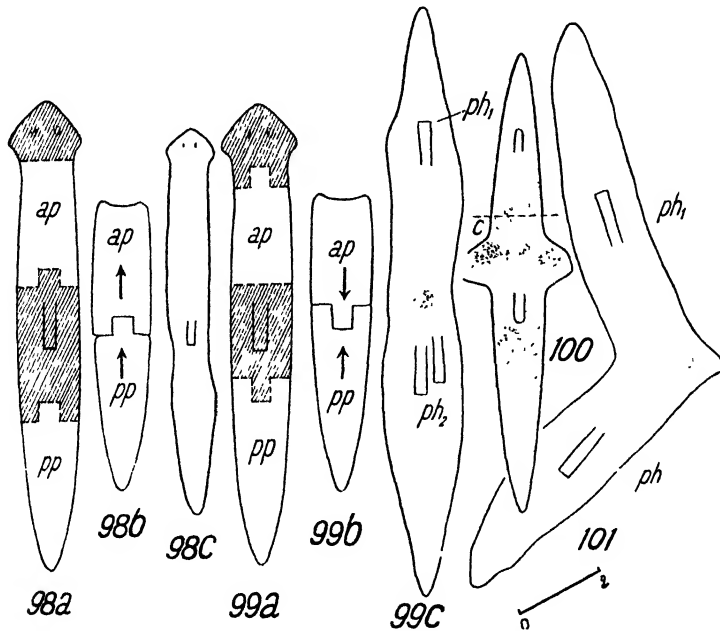
Fig. 98. Combination of pre- and postpharyngeal parts in normal orientation, a, showing size, form and position of two components, b, mode of union, c, result of 9 days. *ap* prepharyngeal piece, *pp* postpharyngeal piece.

Figs. 99 101. Combinations of pre- and postpharyngeal parts in reversed orientation, fig. 99 a, showing size, form and position of two components, b, mode of union, c, result of 30 days. Fig. 100, prepharyngeal component with concave surface and postpharyngeal component with convex surface, 22 days. Fig. 101, another example of the reversed union of a prepharyngeal part with a postpharyngeal part, 36 days.

cut surface of this complex, in accordance with the intrinsic polarity of the smaller component, a tail was regenerated. On the other hand, a head developed as might be expected from the posterior cut surface of that part which had been cut off. This part, then, developed into a perfect worm. In the case of fig. 101, a small projection was formed after union at the left anterior end of the prepharyngeal piece. It functioned as a head for both components, though no eyes after all were formed in it. The three specimens, which were above described, though provided with well-developed pharynges were never observed to react upon, much less to take the food that was given. It is assumed that although presence of a head is not necessitated for an animal to take food, it is needed at least that it should as a whole be possessed of

some sort of orientation. Since no definite orientation was found in such tail bipolar forms as the above, it may be considered that all the physiological functions including food-taking could not be here in normal order.

18.   Union of two prepharyngeal pieces in normal orientation

When two prepharyngeal pieces, both in normal orientation, were united one behind the other as indicated in fig. 102 a, a head and a tail were regenerated respectively at the anterior end of the anterior piece and at the posterior end of the posterior piece, and a pharynx, moreover, was produced within the posterior piece, a complete worm thus resulting (fig. 102 b). A small amount of new tissue then formed along the line of union between two components. In the case of fig. 103 in which union was incomplete, a head developed at the right anterior end of the posterior piece. It came afterwards to be directed at right angles to the main axis of the union complex.

19.   Union of two prepharyngeal pieces in reversed orientation

As indicated in fig. 104 a, two pre-pharyngeal pieces which were similar as those employed in the previous experiments were united by their posterior cut surfaces, one of the grafts being in reversed antero-posterior orientation. A head was regenerated at each end that remained free. While both components in this case elongated themselves decreasing at the same time in width, no tissue was newly formed on the plane of union and no pharynx developed (fig. 104 b).
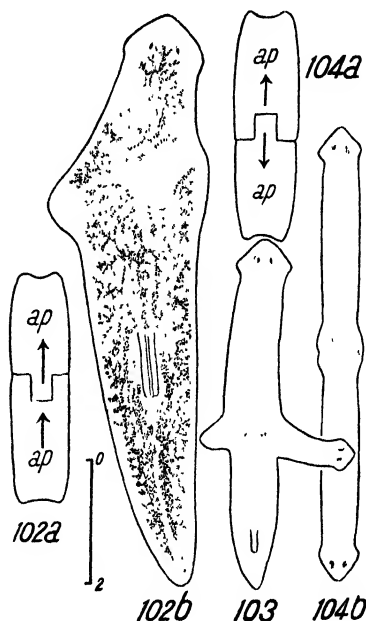
Figs. 102–103. Combinations of two prepharyngeal parts in isopolar direction, fig. 102 a, showing mode of union, b, result after 25 days, drawn from the mounted specimen. Fig. 103, lateral head produced at the united level, 14 days.

Fig. 104. Combination of two prepharyngeal parts in heteropolar direction, a, showing the mode of union, b, result after 26 days.

20.   Union of two postpharyngeal pieces by their anterior cut surfaces

When two tail pieces which were taken from approximately the same levels were united in reversed orientation by their anterior cut surfaces, new tissue was not formed at all along the line of union (OKADA and SUGINO, 1934, II, fig. 2). In some specimens, though a mouth opened ventrally on the median line at the level of union, no pharynx developed after all. This experiment

was already conducted by GOETSCH (1921) and LI (1928), their results being identically the same as ours.

21. Interchange of positions between pre- and postpharyngeal regions

If a prepharyngeal piece of which the head had been removed be united in normal orientation with the posterior end of the postpharyngeal piece of which the tail had been removed, new tissue arose on the plane of union (figs. 105 c–108). The polarity established in the new tissue, however, was reversed to the original polarity of each of the two components. Accordingly, a pharynx in reversed direction (ph_1) was formed in this tissue. Further, another pharynx with normal orientation developed in the prepharyngeal piece (ph_2). Thus in all, three pharynges were obtained. Fig. 105 c and Fig. 106 show specimens, each of which was derived from the union between a prepharyngeal and a postpharyngeal piece, the anterior cut surface of the former having been cut in a shape of ⊓, while the corresponding posterior cut surface of the latter in a shape of ⊔ (fig. 105). Fig. 107 b and fig. 108 are the results obtained from the experiments, in which the grafts to be united were provided with such cut surfaces that were opposite in shape to those in the preceding experiments (fig. 107 a).
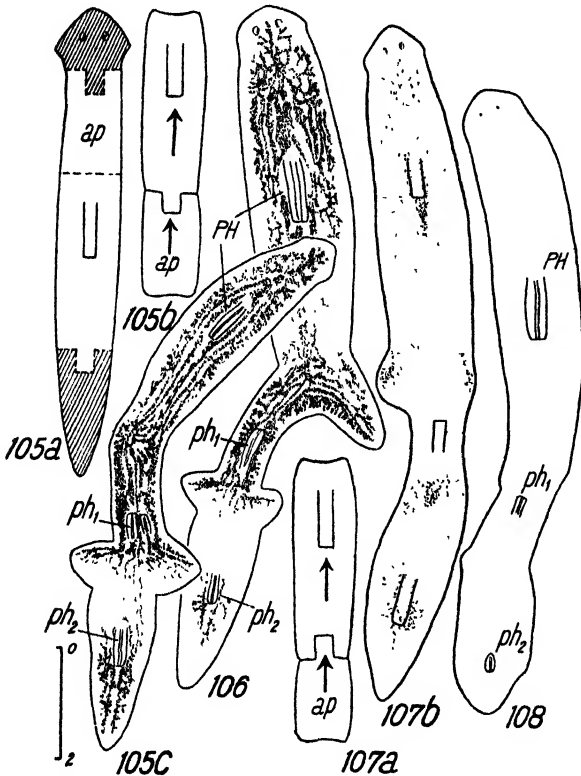
Figs. 105–108. Displacements of pre- and postpharyngeal regions in normal direction, fig. 105 a, showing size, form and position of parts used for the experiment, b, mode of union, c, result after 13 days, drawn from the mounted specimen; fig. 106, another specimen of the same experiment, 19 days. Fig. 107, prepharyngeal component with convex anterior surface and postpharyngeal component with concave posterior surface, a, showing the mode of union, b, result after 16 days; fig. 108, another example of the same mode of combination, 12 days. Notice the appearance of an extra pharynx or pharynges between two components in reversed direction; PH old pharynx in the pharyngo-postpharyngeal component; ph_1 pharynx produced in the new tissue; ph_2 that regenerated in the prepharyngeal comopnent.

The results of the above experiments on the union of large pieces may be summarized as follows. If union occurs between the prepharyngeal and the postpharyngeal pieces, no matter in what way they may be united, new tissue always appears between two components, and regardless of the union being normal or reversed, pharynges that may be formed are always directed from the prepharyngeal towards the postpharyngeal region. Thus, the union between a piece anterior to and a piece posterior to the pharynx is a preliminary indispensable for the development of a pharynx, whereas the presence or the regeneration of a head does not by itself constitute a necessary condition. On the contrary, when two prepharyngeal or postpharyngeal pieces which have been taken from approximately the same levels are united by their cut surfaces, new tissue is never formed. In these cases, even if a head is formed at each end of the complex, no formation of pharynx, needless to say, is ever observed.

III. Union of Lateral Halves

As was already stated in the introduction, it is the aim of this series of experiments to investigate the mutual influence of the components which appear in a complex, when different regions of planarians that have been longitudinally cut are united uninterruptedly by their lateral cut surfaces from the head to the tail end. The methods of experiments are as follows. Two worms of approximately the same length are chosen, first deprived of the head as shown in fig. 109 a, and then longitudinally cut into halves. A lateral half, right or left, of a worm is interchanged in normal orientation with that of the other (fig. 190 b). Or a half of a worm is brought into union in reversed orientation with the half of the same side of another worm (fig. 109 c).

Fig. 109. Diagrammatic representations of homo- and heteropleural reindividualization. a, showing division of worm into halves, b, mode of heteropleural and c homopleural combination.

22. Interchange of a lateral half between two individuals

Those which constitute the first series of experiments were heteropleural union of the right half and the left half of the worms longitudinally divided. In 4 among 5 successful cases one half was united with the other in normal dorsoventral orientation, and in the remaining case in reversed dorsoventral orientation. In addition, one more case will also be described in which the left half of the prepharyngeal region of a worm was united with

the right half of the postpharyngeal region of the same worm.

When the lateral halves to be grafted were placed in normal dorsoventral orientation and brought next into complete union, a normal head was regenerated, some unevenness of the anterior surface of the complex at the time of union being negligible; new tissue was not formed between the halves except some colourless trace of union along the median longitudinal line of the compound body. In figs. 110 and 111 are given sketches of the internal structure from mounted specimens which were fixed (the complex of fig. 110 after 23 days, that of fig. 111 after 26 days) and cleared, and in each of these cases two pharynges were regenerated; the original pharynges had been removed at the time of operation. It may further be seen how the intestine once disorganized by the cut becomes gradually repaired and reconstructed. That two pharynges were formed is considered to be due to the fact that two halves were united by somewhat different levels instead of exactly by the same. For in another example in which the union seemed to be more complete (OKADA and SUGINO, 1934, II, fig. 5), only one pharynx was formed provided none the less with two mouth openings.

In fig. 112 is shown a case of incomplete union of two halves, for each of which a head and a tail regenerated with the subsequent formation of a pharynx.

Fig. 113 represents a case in which the left half of the prepharyngeal region was brought into union with the right half of the postpharyngeal region (fig. 113 a). Each of them regenerated its fellow-half which was lacking on the other side. A head was completed at
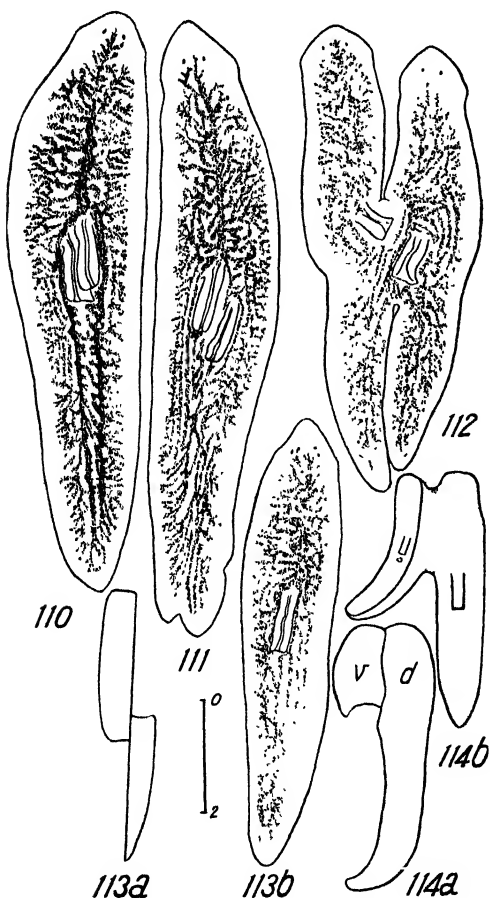
Figs. 110-114. Heteropleural combinations; fig. 110, result of 23 days; fig. 111, of 26 days; fig. 112, incomplete reindividualization in 26 days; fig. 113, oblique union of an anterior half (prepharyngeal region) of the left side with a posterior half (postpharyngeal region) of the right side, a, showing the mode of union, b, result after 26 days. All drawn from mounted specimens. Fig. 114, combination of two right halves, one in normal and other in dorsoventrally reversed orientation, a, state after 3 days, when posterior greater part of the left partner dropped off, b, 71 days, two worms without head united back with back.

the anterior and a tail at the posterior end of the complex, and a pharynx was formed in the new tissue at the level of union (fig. 113 b).

In the only one example of dorsoventral reversed union, the posterior end of one component had fallen off (fig. 114 a). While two anterior ends of this specimen had been healed over separately, no head was regenerated from either of them. Consequently no eyes developed. As days passed, each of the components got to separate own dorsal epithelium from that of the other, and the final result was reached in which two headless individuals were combined back with back (fig. 114 b).

23. Homopleural combination

In all 10 cases of experiments, with the exception of 2 in which one component was displaced in relation to the other so that they were united only by the posterior ends, each component regenerated a head and a tail and gradually diverged from the tail and the head of the other component, the final result being a cross-shaped twin.

Fig. 115 a indicates the state of things when 6 days had elapsed after two left halves were united with each other. The projection which appeared from the anterior end of each component was cut at the level indicated by a broken line in the figure. This complex continued clockwise rotatory movements, the middle point of the body as the centre, on a fixed spot in the vessel. Meanwhile, about 16 days after the first operation, two eyes appeared at the one, and another at the other end of the complex, as indicated in fig.
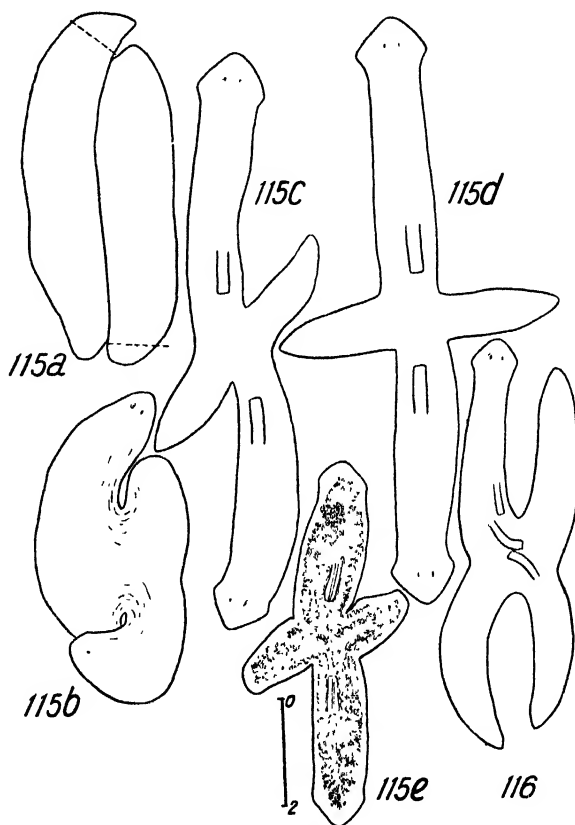
Figs. 115–116. Homopleural combinations; fig. 115 a, 6 days, anterior end of each component removed; b, 10 days; c, 33 days; d, 43 days later; e, the same specimen in the fixed state, showing the intestinal branching. In fig. 116 head regeneration inhibited in one component and 3 pharynges appeared in the fused part, 29 days.

115 b.　New tissue was formed between the head of one component and the tail of the other; between these an incision arose and deepened, so that those parts which had been united together became gradually separated; finally, an independent worm, so to speak, developed on each side.　An independent pharynx was formed, of course, in each component.　The state of the complex on the 39th day after operation is figured in fig. 115 c.　According as the tail of each component was brought into completion the complex took a cross-shape as outlined in fig. 115 d.　In fig. 115 e in which a sketch of the internal structure is given from the specimen fixed 10 days after the state in fig. 115 c, it can well be seen how a posterior intestinal branch of one component enters into the tail region of the other.　In all the other cases the results were the same as in this.

But two pharynges were sometimes formed in one component.　Moreover, in one of such cases head regeneration was inhibited in one component (fig. 116).　In this specimen, furthermore, each of the two pharynges which developed in the reversed direction at the level of union was directed not towards the tail which belonged to the same component as it did, but towards that which belonged to the other.　This fact seems to indicate that the pharynx is formed in such cases in cooperation with the post-pharyngeal region of the strange component which occurs to lie near by rather than with that of the proper component which lies far apart.

Figs. 117 and 118 are examples in which two components were, at the time of operation, so much displaced on the surface of contact that they were united with each other only by a small portion at the posterior end.　The state of things on the 15th day after operation is given in fig. 117 a, in which an eye is seen to have been developed at each end.　In fig. 117 c is represented the complex on the 38th day after operation and when it was contracted, and in fig. 117 b the same when it was relaxed.　In fig. 118 is shown a complex developed from the homopleural combination of right halves, the figure being drawn from the

Figs. 117–118.　Incomplete unions of two halves in homopleural combination; fig. 117, combination of left halves, a, 15 days; b, 38 days; c, the same in the contracted state.　Fig. 118, combination of right halves, 31 days, showing the intestinal branching.

mounted specimen fixed on the 31st day after operation.　In such cases a pharynx was formed independently in each half, and the intestine which

belonged to one half did not enter into the other half.

To sum up the results above described, when two lateral halves of planarians are combined at the corresponding levels, new tissue is not formed between them. Hence, when different regions of heteropleural pieces derived from two worms are intimately united at their corresponding levels, all the regions and the organs of the complex are of single formation. On the contrary, when one component is combined with the other in reversed orientation, different regions come to be united at different levels, and new tissue arises along the whole line of union, that derived from one component behaving as if it drives away that from the other so as to supplement the lost half by itself. Hence, here results always a twin which is partly united.

SUMMARY OF THE EXPERIMENTS AND CONSIDERATION OF THE RESULTS

I. Fate and influence of the graft on the host: Considering the data of experiments of the first category, we are led to conclude that the fate of a grafted piece is determined in the first place by its origin, in the second place by the level of transplantation, and in the third place by the mode of union with the host (i. e. the degree of union and the orientation).

1. *Head grafts:* The head piece, no matter in what region and in what orientation it may be grafted, always develops into a head. Its influence on the host is great.

According to SANTOS (1929, '31 p. 152), the development of the head graft can be distinguished into two types, i. e. (1) when transplanted into the prepharyngeal region, it induces an outgrowth from the host, and (2) when transplanted into the pharyngeal region or a more posterior level, it induces reorganization of tissue and development of new pharynges. Similar phenomena were also observed in our experiments. If the so-called outgrowth referred to above develops on the dorsal surface, it is covered only with the dorsal epithelium, and if on the ventral surface, it is covered only with the ventral epithelium; the epithelium on the other side of the graft becomes enclosed into the interior. The outgrowth developed on the host dorsal surface passes at its base into a cylindrical peduncle which is covered only with the dorsal epithelium. In the ordinary course of events, the peduncle becoming more slender as time passes, the graft eventually comes to be isolated here and falls off from the host. This phenomenon is due, according to GEBHARDT (1926 p. 692), to constriction of a ring which is made of secreted slime. A slime ring coiled round the peduncle of an outgrowth was, in fact, of frequent occurrence in our experiments. Although the slime ring was removed soon after it was formed, the graft head could not in nearly all the cases avoid the fate of falling off. Its cause may not, therefore, be so simple that it can be sought in the constriction of a slime ring. But, if the ventral epithelium is invaginated deep into such an outgrowth and if it is, furthermore, in connection with the host ventral epithelium, the graft head in question never falls off. It does so only in those cases in which the peduncle is barely possessed of

the dorsal epithelium. It may be supposed that the dorsal epithelium exerts incessantly a sort of mechanical pressure towards the interior in such a way that the latter causes the peduncle to be constricted. On the other hand, it may be considered that the physiological dominance of the host head inhibits the graft head from developing and leads, furthermore, to the absorption of the latter; but if the physiological dominance were the sole cause, all the graft heads might be led ultimately either to absorption or to falling off. It may also be supposed that responsible here is the absence of nervous connection between the graft and the host, but this point could not be made sure because of our lack of histological observations. In brief, a cylindrical body covered only with the dorsal epithelium, a formation far apart from the original flat condition of planarian organization, is, as a matter of fact, by no means perpetual. On the contrary, an outgrowth formed on the ventral side and covered only with the ventral epithelium never falls off. This may be attributed to the peculiarities of the ventral epithelium in contradistinction to the dorsal, but it may also be supposed that a ventral outgrowth endures because of a connection easily realized between ganglia of the graft head and nerve-cords passing ventrally of the host.

When the dorsal and the ventral epithelia are united each with the corresponding epithelium of the host, no development of the so-called outgrowth occurs. Here new tissue always appears along the line of union, not only, of course, when union is complete, but also even when cut surfaces are partly exposed. Hence when union is complete on all sides, new tissue appears along the whole line of union, an elevation being formed either on the dorsal or the ventral surface with a corresponding depression on the opposite side.

According to SANTOS (1931, p. 159), outgrowth is formed from the graft more frequently on the dorsal than on the ventral surface of the host, since it is more easy for an outgrowth to develop on the dorsal than on the ventral surface because of the lack of resistance offered by the bottom of the vessel. But that in which direction, dorsal or ventral, the graft develops depends, according to our observation, rather on the depth at which the graft is buried at the time of operation.

On the reorganization of host tissue through the head graft, SANTOS (1931, p. 153) states as follows. The development of the postcephalic outgrowth as well as the reorganization of the pharyngeal or the postpharyngeal region does not represent regeneration in the strict sense of the word. The former proceeds much less rapidly than the reorganization of tissue and is not accompanied by any formation of new or embryonic tissue. Still less the reorganization of tissue in the pharyngeal or the postpharyngeal region is regeneration, for it proceeds very slowly without any morphological change of the body, except cell divisions and growth for the formation of new pharynx and for the reconstruction of intestinal canals. SANTOS evidently observed no appearance of new tissue in these cases, but states the fact that in the case of prepharyngeal or pharyngeal graft new tissue appears, and the graft migrates

either anteriorly or posteriorly from the level of transplantation.   As already stated, it was demonstrated in our experiments that in the case of head graft also, when each of its dorsal and ventral epithelia was brought into normal and complete union with the corresponding epithelium of the host, new tissue always formed along the line of union: in the head grafts with *dd-vv* union, as shown e. g. in fig. 2, new tissue was always observed to appear between the graft and the host, whether or not a cut might have been made secondarily upon the host either anterior or posterior to the graft.   Why does not new tissue appear along the line of union, when both the dorsal and the ventral epithelia of the graft are united merely with either the dorsal or the ventral epithelium of the host?   It is probably because the postcephalic outgrowth that has been induced through the graft is cylindrical in form, and the graft head itself is radial to a certain extent, i. e. multipolar as SANTOS calls it.   In those cases of incomplete transplantation which may be the cause of such an outgrowth, the anterior end of the head is formed on the anterior cut surface of the graft by the union of the dorsal and the ventral epithelia of the graft themselves, while a physiologically anterior end is also formed at the opposite end of the graft, here constituting the so-called heteromorphic head end, the line of union of the graft ventral epithelium and the host dorsal epithelium being taken as the edge.   As the physiologically anterior end had thus been occupied exclusively with the old tissue, there was left no more room for the formation of new tissue along the line of union.   Within the scope of our results of experiments, in those cases in which the ventral epithelium of the head graft was so united as to be surrounded with the dorsal epithelium of the host, there resulted invariably a biaxial heteromorphic head by the cooperation of the two components of the grafting (figs. 6, 7, 13, 14).   Here notwithstanding GOETSCH's account, new eyes are formed as easily in the old tissue of the host as in that of the graft.   The appearance of these eyes may be taken for an indication of the biaxiality acquired by the graft head.

The graft head of a cylindrical form which has developed in the host prepharyngeal region and is provided with a peduncle covered only by the dorsal epithelium can not inhibit the head regeneration on the anterior cut surface of the host, when the host head is removed at a level immediately before it.   Although one may be allowed to assume that the peduncle represents physiologically a postcephalic or a prepharyngeal region, it can never be adopted in reality as the corresponding region of the host, but a new and separate head is regenerated from the host.   Hence, the claim by RAND and BROWNE (1926) can not hold here, that the physiological dominance of the graft head exerts an inhibitory action upon the regeneration of the host head.   On the contrary, in those cases of so-called complete union, in which each of the dorsal and the ventral epithelia of the graft head is united with the corresponding epithelium of the host, the head of the host can easily be replaced with that of the graft.

When a head piece is transplanted into the postpharyngeal region and union complete, new tissue appears along the line of union, and at the levels

anterior and posterior to it either in the host or in the new tissue two pharynges in opposite direction make their appearance. The polarity of the host tissue anteriór to the graft has evidently been reversed. Thus, it may be said with SANTOS that the ganglionic region acts as an organizer for the development of organs, including the pharynx.

The preocular region or the auricular lobe also, when employed as the graft, develops approximately the same as the ganglionic graft, and exerts its influence upon the host in a similar way, but to a lesser extent than the latter.

2. *Prepharyngeal grafts*: When a small piece taken from the prepharyngeal region is transplanted into the postpharyngeal region with complete union, new tissue appears along the lines of union. If a cut is made secondarily along a line of union to expose again a part of the graft, a head is always regenerated from the exposed cut surface regardless of the position of the latter; the effect of the graft on the host is nearly the same as in the preceding case of the head graft, development of new pharynges being induced. When the graft piece is intimately united on all sides with the host, dorsal elevation is formed accompanied with no head development, and yet two pharynges in opposite direction are induced anteriorly and posteriorly to the graft level (figs. 54, 55, 57, 58). These results of experiments suffice to prove that induction of the pharyngeal development is possible without either a head or a brain. It is further shown that such a graft can reorganize that part of the host tissue which is situated anterior to the graft level, causing the polarity of the latter to be reversed. Hence, we know that such a function as to cause the differentiation of organs on the part of the host is not necessarily delimited to the ganglionic region.

3. *Pharyngeal grafts*: If a small piece which is taken from just before the pharynx and yet does not include the original pharynx is brought into the prepharyngeal region, a pharynx develops in the graft. As in this case that portion which intervenes between the pharynx and the intestine is included in the graft, it may be supposed that a pharynx will be regenerated therefrom. Nevertheless, if such a piece is transplanted into the postpharyngeal region, frequently no development of pharynx occurs. Hence, the development of pharynx in the previous case cannot simply be regarded as a process of regeneration, but rather an agent on the part of the host, which may probably be called an impetus for the development of pharynx, must be considered to have played a more important rôle.

In one case in which a small piece including the pharyngeal basis was transplanted into the prepharyngeal region, a pharynx was not only regenerated, but another one also developed in the graft. On the other hand, when a similar piece was brought into the postpharyngeal region, apart from the formation of a mouth opening no influence could be observed either of the graft on the host or vice versa. In the transplantation of a small piece which is derived from the middle of the pharynx, the dependence of the results on the level at which the grafting is made is more conspicuous: when the piece is grafted into the prepharyngeal region, a pharyx is formed there evidently under

the influence of the host, but in the case in which the piece is grafted into the postpharyngeal region no organ is caused to develop there. The above facts may be interpreted also as indicating that in the pharyngeal region itself there exists a gradient of differentiation, which is related to the development of pharynx and decreases in strength from the anterior to the posterior end.

4. *Postpharyngeal grafts :* In the transplantation of a postpharyngeal piece there always arises a tail from the original posterior and a head from the original anterior end of the graft. In these cases, the fate of the graft is due to growth of its own, the pharynx also being developed in it. Here will be given some comparison between the head and the postpharyngeal grafts. In the case of the former, the graft does not grow itself, but either induces the development of new tissue in the neighbouring regions of the host or forces this to carry out the reorganization of tissue. In the case of the postpharyngeal graft, it grows itself and induces the development of pharynx in itself. Here it is suggested that the normal growth of a planarian depends always upon the elongation of the postpharyngeal region.

In the cases where a postpharyngeal piece is transplanted into the prepharyngeal region, if union is complete so that the cut surfaces on all its sides are united, the graft develops into a vesicular form (figs. 69, 70, 71) ; and if union is incomplete, a more prominent outgrowth is formed (fig. 80). There are often cases where an individual worm is completed by the growth of the graft itself (figs. 76, 77, 78). The formation of such abnormal forms is also due to the extension of the graft itself, and in this respect differs much from the formation of the outgrowth in the case of a head graft which consists essentially of a process of extraction from the host tissue.

The results of experiments, in which a posterior piece immediately after fission is taken and a small area near its anterior end is rotated in situ, are very similar to those of experiments, in which a postpharyngeal piece is used as the graft. This is probably because the anterior end of the worm in question is not yet fully advanced in organization, but retains still many of the properties of the postpharyngeal region.

5. *Tail grafts :* When a tail piece is transplanted into the prepharyngeal region, regardless of its orientation, it always develops into a tail and at the same time grows in length. Whether the new tissue which appears in the meantime between the graft and the host is derived entirely from the graft or partly from the host is a question which is not yet settled. But taking into consideration that the pharynx newly formed is always situated near the old tissue of the host, and that the old pigment of the graft is localized near the tail end etc., it can safely be said at least that the tissue which appears between the graft and the host is larger in quantity than that which is produced at the tail end.

II. Change or reversal of polarity in the graft: In a small piece that has been transplanted change or reversal of the polarity often takes place. In the case of a head graft, when both its dorsal and ventral epithelia unite merely with the host dorsal epithelium and a head develops that may vary

in form according to cases, its polarity can easily be changed, and eyes are newly formed always in the direction of the head development, either in the graft or on the dorsal epithelium drawn in that direction out of the host. Further, when a head piece is grafted into the prepharyngeal region with reversed orientation and the host tissue before it is removed, a head is formed on its posterior cut surface. In transplantation of a similar head piece into the postpharyngeal region with normal orientation, if the host tail region behind the graft is removed, a head is also formed on its posterior cut surface. Moreover, a head graft is able to develop into a head not only in those cases in which it is transplanted in reversed anteroposterior orientation, but also in those cases in which it is united with the host merely by one of its lateral cut surfaces. In these cases a head is developed from the cut surface on the opposite side. Hence, in whatever region and in whatever orientation a head piece may be grafted, it always develops into a head and never gives rise to any other structure than itself. And the orientation, i. e. the polarity, of the head formed is determined by the mode of union between the graft and the host at the time of operation. Hence, if the graft is united completely on all its sides with the host, the antero-posterior and the mediolateral gradients in the graft being lost, a radial structure, the graft as the centre, is to be produced. New tissue is formed, as already mentioned, around such a head, giving rise here to a vesicular elevation. This is a proof that the graft has become the centre of the new beginning of growth. If the vesicular body is opened by a cut at right angles to the longer axis of the host, an anteroposterior and a laevodextrous relation come to be re-established in the portion consisting of new tissue. But an anteroposterior relation is no longer retained in the head region which has functioned as the centre of growth (figs. 32, 34).

If a rectangular piece cut out from the prepharyngeal region is reunited in situ in reversed anteroposterior orientation and the host tissue anterior to it is removed by cutting, a head develops in almost every case. If a similar piece is transplanted into the postpharyngeal region in reversed orientation and the part of the host anterior to it is removed, a head also develops from the anterior cut surface, i. e. the original posterior cut surface of the graft. Further, if also a similar piece is brought into the postpharyngeal region in normal orientation and the part of the host posterior to the graft level is re-moved, a head develops from the posterior cut surface. In these three cases the direction in which the head develops is clearly reversed in relation to the polarity of the grafted piece. This is probably because the potency of head formation within the small piece is very much dominant over the surrounding host tissue.

If a small area in the prepharyngeal region is rotated in situ and the host posterior part is removed, in most cases a head, but occasionally a tail, develops from the posterior cut surface, i. e. the original anterior cut surface of the small piece. In the latter case where a tail develops the polarity of the graft has come to be reversed. Hence, it may be said that in the pre-

pharyngeal region reversal of the polarity is a comparatively easy matter, either a head or a tail being formed according to cases. But, here much influence seems to be exerted by the power of regeneration of the host tissue neighbouring the exposed cut surface of the graft on one hand, and by the level at which transplantation is made on the other.

As in our experiments of transplantation of the pharyngeal pieces no secondary cut was performed, we were not in a position to find out anything about the change of polarity at the time of their regeneration. But whether the graft may be placed with normal or reversed orientation, its influence on the host is almost the same, no difference in the results being observed with regard to its orientation. Therefore, it becomes rather doubtful whether the original polarity of the graft is still preserved after transplantation.

But change of the polarity rarely occurs in the postpharyngeal graft, from which in most cases in accordance with its original polarity either a head or a tail is regenerated. This fact can be attributed not simply to any characteristic of this region to preserve the polarity of its own, but to the tendency for tail formation which is particularly strong on the posterior cut surface of the graft itself. For the polarity of this region as a whole can easily be reversed, as is known, by grafting therein a head or a prepharyngeal piece. In brief, the tissue of this region is provided with so much tendency towards elongation, that when transplanted into other regions it appears very obstinate to preserve its polarity.

In the case of a tail graft a tail always develops either from its anterior or from its posterior cut surface. Even if it is transplanted at a considerably anterior level of the host, formation of a head under the influence of the latter can seldem occur.

SANTOS (1931, p. 158) stated that the polarity of the graft was preserved in most cases of transplantations in planarians. In his experiments equilateral triangular pieces, most of which were elongated anteroposteriorly, were used as grafts. Hence, it seems that the form and the length were probably sufficient for the graft to preserve the polarity of its own.

III. Formation of new tissue and morphological organization: Although it was contended by GOETSCH (1929), CHILD (1929) and SANTOS (1929, '31) that a head piece, particularly one including the brain, functions, on being grafted, as the source for morphological differentiations on the part of the host, yet a piece other than the ganglionic, e. g. a preocular or an auricular, when used as the graft, exerts also a similar influence upon the host (p. 395). Further, when a prepharyngeal piece is transplanted into the postpharyngeal region and united on all sides, whether a head regenerates or not, it also acts upon the host tissue as an organizer and induces development of new pharynges (p. 401). Hence, what can function as an organizer is, it is clear, by no means restricted to the ganglionic region. But the capacity for organization is evidently in different degrees, the difference being directly manifested in the distance between the graft and the new pharynx induced, and the ganglionic region proves in such a manner to be the strongest organizer.

When any two portions of planarians are united, formation of new tissue either occurs or not.   That is, if two portions which have come to be joined together are derived from different levels of the body and lack something either morphological or histological which is to intervene between them, new tissue always appears.   Such an example was already given also by LI (1928), who deprived an planarian of its pharyngeal region and made the anterior and the posterior portions thus derived reunite in their original orientation.

GOETSCH (1921) considers that the regeneration may be attributable to the lack of either the anterior or the posterior portion of the body, and that "Verwachsung" inhibits regeneration.   On the other hand, LI maintains that the presence of a cut surface does not represent an indispensable condition for regeneration, and that the cause for inhibition of regeneration in the case of the heteropolar union of two tail pieces is to be found not in "Verwachsung" itself, but in the heteropolarity at the time of "Verwachsung".   But through the results of our experiments it is shown that these conditions which were set forth hitherto still do not suffice.   For, in a case of heteropolar union of two planarian pieces where a prepharyngeal piece is chosen as one component and a postpharyngeal piece as the other (p. 421), new tissue also arises along the line of union and a pharynx is induced to develop. Thus, in the cases where the so-called "Reiz der Fehlenden" of GOETSCH is put out of place, as also in the cases where a heteropolar union as claimed by LI takes place, the formation of new tissue does occur, either of the suppositions of the above authors notwithstanding.   On the contrary, if two prepharyngeal pieces are united with each other in reversed orientation, i. e. by their posterior cut surfaces (p. 423), or similarly if two postpharyngeal pieces are brought into a heteropolar union with each other by their anterior cut surfaces (p. 423), no new tissue regenerates along the line of union.   In these cases it is observable only that both components gradually decrease in width increasing at the same time in length.   It may be inferred from the above that the very cause for the formation of new tissue is the lack, between the cut surfaces of two parts to be united, of some portions that ought to be present in a normal worm.   On the other hand, inhibition of this type of regeneration may be taken for a proof that there are no parts physiologically lacking between two components.   In other words, when union occurs between two worms at the level which corresponds to each other, no regeneration can take place along the line of union.   It is here beside the question, whether the union between two components may be homo- or heteropolar.   Hence, the formation of new tissue implies a lack in a physiological or morphological sense between the cut surfaces which have been brought into union.   Further, as regards the direction in which proliferation occurs and the polarity of the new tissue, the prepharyngeal region is always taken as the anterior and the postpharyngeal as the posterior end.   This fact is more clearly demonstrated in those experiments (figs. 105, 106, 107, 108) in which a prepharyngeal region is brought posteriorly into a homopolar union with a postpharyngeal region.   In these cases the polarity of the new tissue is reversed in spite of the homopolar union of the two

components. It cannot here be decided within the scope of our experiments, whether the new tissue is derived from one or from both of the components.

Through the results of our experiments in *Planaria gonocephala*, it is confirmed that an anterior part has always an effect as an organizer upon more posterior parts, this power being continually decreases from the head end towards more posterior levels.

GOETSCH (1929) states that a highly specialized graft has a power, when the host head removed, to make the host tissue differentiate. Here, according to his opinion, not the entire body of the host is affected, but those undifferentiated or changeable elements which have been drawn out by the graft (e. g. a head piece) come to be reorganized. But it is evidently proved by SANTOS (1929, '31) that the regions originally present can be subjected as an entirety to a change of polarity.

It was noticed by CHILD (1929) that when regeneration occurs from a planarian piece, the source for the organizing action is localized at the head that has been regenerated. That is to say, the determination of the head is the first to occur at the time of anterior reconstitution of a planarian piece that has been amputated, and the head thus formed induces the development of the more posterior regions. A piece taken from the prepharyngeal region may not occasionally suffice for the regeneration of a head, but it is able to induce the development of a pharynx in the following regions and also the reconstitution of the intestine. A postpharyngeal piece, however, can induce neither the development of a pharynx nor that of prepharyngeal organs, unless regeneration of a head occurs in advance. But it can regenerate such regions that are situated posterior to itself. If such a regenerating piece contains in itself a small quantity of either the prepharyngeal or the pharyngeal tissue, it can induce the development of a new pharynx and a mouth, though not of a head. Thus, it is claimed that the law of anteroposterior differentiation can also be applied to the reconstitution of organs in planarians.

In the experiments of transplantation also, it is absolutely necessary for the development of new pharynx or pharynges that a prepharyngeal part should be united with a postpharyngeal part. This furnishes a direct proof for CHILD's theory. Whether the components may be united in normal or reversed orientation, or whether they may come to be united side by side, so far as one of them is derived from the prepharyngeal and the other from the postpharyngeal region, a pharynx always develops between them. These facts are evident in the light of the results of our experiments which are arranged in the last category. But, that the formation of new tissue does not represent necessary preliminaries for the development of pharynx can be seen from the fact that when the pharynx is excised from a normal worm, or that when two longitudinally cut halves are brought into a heteropleural reindividualization, a new pharynx is formed without accompaniment of any formation of tissue along the line of union.

To sum up, new tissue does not appear when union occurs between two corresponding levels of the worm body, but it does appear along the line of

union when union occurs between two different levels which are at some distance from each other. The amount of tissue newly formed is larger in proportion to the original distance between two cut surfaces to be united, as such is also the case with the organizing capacity. With this reasoning such a phenomenon as the elevation or the invagination at the level of transplantation can easily be explained. Furthermore, the problem as to what causes the migration and also what determines the direction in which the graft migrates, the problem which SANTOS (1931, p. 158) left unsolved, will also prove to be self-evident. He expresses his opinion that the backward migration of a pharyngeal graft which has been transplanted in reversed orientation is due not only to the pressure of the new tissue formed there, but also to another factor finding in the process of transplantation itself. But from our point of view, it is nothing but a natural result from the fact that the graft is pushed from the level of production of a larger quantity of new tissue towards that of smaller.

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POSTSCRIPT

As the results of our present study were going to press, SCHEWTSCHENKO's paper was published*. He transplanted a rectangular piece including the brain into the postpharyngeal region after it was rotated either anteroposteriorly (Serie I) or transversally (Serie II). When union occurred on a cut surface which was now set posteriorly (in other words, either at the anterior end or on one of the lateral sides of the graft), a head developed in the direction either reversed or at right angles to the original polarity of the graft. Similarly, in the case of union occurring at both anterior and posterior ends of the graft (Serie III), two heads were formed in directions other than the original. In both cases a peduncle corresponding to the postcephalic region was formed out of the tissue which was drawn out from the host.

The above results are nothing more than those of cases which are included in our present report under the heading " Incomplete union " in Experiment 2 ; " Transplantation of the ganglionic piece into the postpharyngeal region ". It was already shown by SANTOS and is also clearly demonstrated in our experiments that such a graft including the brain is in itself so qualified that no matter into what region, except the cephalic, it may be transplanted, it always develops into a head, the direction in which transplantation is made remaining here beside the question, for a new head always begins to develop from that cut surface which is left free. That the anterior cut surface of the graft comes to be united, while a head is formed at the other end, is a phenomenon, as a matter of course, opposed to the polarity of the graft itself. Regarding this problem, the polarity reversal of the graft, ample discussion is given in the second item (p. 433) of the chapter of conclusion in our paper.

One of SCHEWTSCHENKO's results which is not in accord with ours is the case in which an independent worm resulted with a tail derived from the graft. This, however, probably represents a differentiation from that portion which is drawn out from the host. He further states that new eyes are formed only in newly formed tissues, but not in old ones. Concerning this question we have already testified to the incompleteness of observations to which GOETSCH owes his similar proposition. SCHEWTSCHENKO makes, finally, no reference to the induction of pharyngeal development in his account of transplantations of such a ganglionic graft into the postpharyngeal region. Was the reversal of polarity restricted in his cases within the so-called outgrowth drawn out by the graft piece, or did the change of polarity in general not extend, the level of transplantation as the centre, over the whole tissues of the graft, as was observed as well in the experiments of SANTOS as in ours?

*Zool. Anz., Bd. 115 (1936) pp. 232-244.

19. La Stolonisation et les Caractères sexuels du Stolon chez les Syllidiens Polychètes
(Études sur les Syllidiens III)

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(Avec la planche XXIII et 30 figures dans le texte)

INTRODUCTION

Ce n'est pas une chose extraordinaire chez les animaux invertébrés qu'en cas de reproduction asexuée par scissiparité transversale la partie postérieure du corps forme une tête avant de se séparer de la souche et que deux individus alliés viennent à se constituer ainsi. On en trouve de nombreux cas aussi chez les Polychètes. Cependant la reproduction scissipare ou schizogamie chez les Syllidiens faisant l'objet de ce mémoire diffère un peu de celle chez d'autres tribus; sauf un cas particulier, tel que la fragmentation chez les *Syllis gracilis* et *Procerastea Halleziana*, la schizogamie ne vise pas directement la production des nouveaux individus, et dans le cas où l'animal fait une reproduction sexuée, elle a le rôle de charger et répartir les éléments sexuels. Il existe donc une certaine différence de structure entre l'ancien et le nouvel individu. Dans ce cas, les rapports entre le corps-mère ou souche et le stolon ou zooïde peuvent être comparés à ceux entre le polype et la méduse chez les Coelentérés. De même que la méduse est une métamorphose fonctionnelle du polype, le stolon se développant en une Syllide se transforme pour accomplir sa fonction spéciale de reproduction: les changements les plus caractéristiques sont la transformation des parapodes en nageoires, l'apparition des soies natatoires, l'indication des caractères sexuels secondaires dans la région céphalique, etc. Sauf cette métamorphose fonctionnelle des nouveaux individus, la stolonisation chez les Syllidiens ne diffère point de celle chez d'autres tribus de Polychètes. La caractéristique de cette tribu, si l'on veut la chercher, serait la formation d'une chaîne de stolons chez les genres *Autolytus* et *Mirianida* ou l'arrangement des stolons en faisceau chez certaines espèces du genre *Trypanosyllis*. Mais en suivant inversement les stades de leur développment, on peut réduire cette stolonisation particulière à une forme primitive qui est la division du corps en deux parties, antérieure et postérieure. D'autre part, la ramification du corps de la *Syllis ramosa*, qui est souvent citée comme le bourgeonnement le plus étonnant n'est, au point de vue de la stolonisation, qu'une division très simple provoquée indépendamment et simultanément sur chacune de ses nombreuses branches.

Or, depuis que O. F. Müller (1788) avait dessiné un petit ver, sa *Nereis*

prolifera, en voie de division, ce mode de reproduction des Syllidiens a intéressé de plus en plus les biologistes européens et aussi américains qui ont publié à plusieurs reprises de nombreuses observations intéressantes. De St.-Joseph (1886), en étudiant la schizogamie surtout des genres *Autolytus* et *Myrianida,* a donné un coup d'oeil sur la reproduction asexuée des espèces connues jusqu'alors. Malaquin (1893), s'appuyant sur une base plus large, a décrit la schizogamie des Syllidiens en général; grâce à lui, le mode de reproduction chez cette tribu a été bien mis en évidence. Ensuite, Potts (1911) a fait une révision générale de la reproduction des Syllidiens, en y ajoutant de nouveaux faits qu'il a recueillis pendant 16 ans de recherches consécutives à celles de Malaquin. Il serait donc superflu de renouveler ici les faits déjà connus en remontant au delà de cette époque. Cependant, il faut remarquer que les descriptions gégérales de Potts ont été presque toutes basées sur les observations des autres auteurs; d'ailleurs bien que ces observations fussent incomplètes ou erronées en elles-mêmes, il les a citées en partie telles qu'elles étaient. Il semble qu'il ait établi trop de modes de reproduction pour cette seule tribu de Polychètes et qu'il n'ait pas bien éclairé les relations entre eux.

Le but de ce mémoire est de reviser ces différents modes de reproduction asexuée et de les mettre en bon ordre. Tous les faits formant la base de cette description s'appuient uniquement sur mes propres observations, sauf le bourgeonnement ventral de certaines espèces de *Trypanosyllis,* observations qui ont été faites pour la plupart au cours de mon séjour d'environ un an à Plymouth en Angleterre, de juin 1927 jusqu'au mois d'avril 1928 et pour le reste dans le Laboratoire Maritime de Séto qui est sous ma direction et attaché à l'Université de Kyôto. En en publiant les résultats, je tiens à exprimer mes remerciements sincères à Monsieur le docteur E. J. Allen, chef de Laboratoire à Plymouth, ainsi qu'à tous ses collaborateurs qui ont bien voulu m'accorder toute facilité et le matériel nécessaire à mes études expérimentales.

MODES DE STOLONISATION

· A. Stolonisation chez les Syllidés

La stolonisation de la *Haplosyllis sponicola* est caractérisée par le fait que les éléments sexuels remplissent presque tous ses segments à partir de la partie presque pharyngienne jusqu'au segment anal et que la division est limitée à une petite région postérieure du corps (fig. 1). En plus, le second individu ne produit jamais de tête; c'est pourquoi, lorsqu'on parle de la stolonisation des Syllidiens en général, on en considère cette forme comme la plus rudimentaire, malgré le changement remarquable des segments. Quant à la reproduction de cette espèce, on trouve une description bien détaillée chez Albert (1886). Avant la séparation d'un stolon, les éléments sexuels mûrissent jusqu'aux deux tiers de la partie postérieure du corps, et la coloration de cette région varie suivant les sexes: pour les femelles elle est d'un violet clair, tandis que pour les mâles elle est d'un blanc opaque ou d'un rose clair. Cependant, chez les derniers la partie qui se sépare comme stolon est

nettement distinguée de la souche, à cause de la pigmentation violet foncé apparu dans l'épithélium du corps. De plus, dans cette région postérieure on voit s'agrandir des parapodes en forme de nageoires, et ensuite se produire un long faisceau de soies natatoires sur la face dorsale. D'autre part, un point noir existant à la base de chaque cirre dorsal augmente de plus en plus de volume ; l'épithélium s'épaissit, présente la forme de lentille cristalline et constitue ainsi une sorte d'oeil. Par contre, le cirre dorsal lui-même se réduit plus nettement qu'auparavant. Dans la structure interne, on remarque une diminution du canal alimentaire et une dégénérescence considérable des muscles dorsal et ventral longitudinaux des parois du corps. Or, par suite de l'accroissement des parapodes et de leur nouvelle fonction natatoire, les muscles spéciaux prennent un grand développement. La dégénérescence de l'intestin et des parois du corps fournit, en revanche, des matières nécessaires au développement des éléments sexuels, d'une part, et cède la place au remplissage des oeufs ou spermatozoïdes, d'autre part. Un autre changement de la structure interne plus marqué chez les mâles est le développement intense des néphridies pour le transport des spermatozoïdes. Cet organe prend en se développant une coloration spéciale et on en aperçoit facilement les contours même par la face extérieure du segment, mais chez les femelles on ne constate pas de développement des néphridies correspondantes. Il semble que la ponte s'effectue aux dépens de la rupture du segment.

Fig. 1. Région postérieure de *Haplosyllis spongicola* observée avant le détachement du stolon mâle.

Au moment de la séparation du stolon, on voit s'écouler au moins un petit nombre d'oeufs par la plaie de l'extrémité postérieure de la souche.

Affectée de tels changements, la partie postérieure du corps se montre à l'extérieur de l'éponge dans laquelle le ver vit en parasite, et celui-ci continue des mouvements vibratoires. Pendant ces mouvements vibratoires la partie

Tableau　I

Tableau synoptique de la stolonisation chez la *Haplosyllis spongicola*.

	1	2	3	4	5	6	7	8	9	10
Numéro des spécimens	1	2	3	4	5	6	7	8	9	10
Sexe	♀	♂	♂	♂	♀	♀	♂	♂	♀	♂
Limite antérieure des segments génitaux	18 me	—	—	19 me	24 me	—	- -	—	—	?
Ordre des segments dans la souche comptés de l'extrémité postérieure — 10								++		
9								++		
8								++		
7								++		
6						++		++		
5				++		++		••		
4				++		++		••		
3			++	••		++	++	••	++	
2			++	••		++	•	••	++	
1			++	••		++	••	••	++	••
Niveau de séparation; Entre les segments	38-39	43-44	50-51	52-53	55-56	65-67	67-68	69-70	73-74	—
Ordre des segments dans le stolon comptés de l'extrémité antérieure — 1		••	?	••	••					••
2		••		••	••					••
3	+ •	••		••	••					••
4	••	++		••	••					••
5	••	++		••	••					••
6	••	++		••	••					••
7	••	++		••	••					••
8	••	++		••	••					••
9	••	++		++	••					••
10	••	++			••					
etc	••	++			••					
Nombre de segments dans le stolon	21	21		15	20	R	R	R	R	15

• • signifie l'élargissement des taches pigmentaires à la base du cirre dorsal, ++ la présence des taches semblables moins développées. R, désigne l'extrémité postérieure du ver en régénération.

postérieure se divise comme un stolon; le mâle, aussitôt libéré, nage vivement dans l'eau; la femelle a des segments bien enflés et remplis d'oeufs. et probablement à cause de la métamorphose des parapodes moins complète que le mâle, elle nage habituellement à peine, même après sa séparation.

Le corps-souche laissé dans l'éponge reproduit les segments postérieurs perdus par la séparation d'un stolon. La régénération se fait suivant le mode qu'on observe généralement chez les Polychètes: l'extrémité de la queue est formée d'abord, la zone de prolifération ensuite, et celle-ci est peu à peu entraînée en arrière en formant de nouveaux segments d'avant en arrière; avant la prochaine stolonisation, le nombre des segments perdus sera presque rétabli, mais il n'est pas sûr que la nouvelle division s'effectue au même niveau que l'ancienne, et parfois elle se manifeste deux ou trois segments plus en avant. Les parapodes qui n'ont subi aucun changement dans la première division éprouvent cette fois-ci le même sort que les segments qui les suivent. En examinant avec un peu de soin les segments qui contribuent à la formation du stolon dans la prochaine division au point de vue de l'avancement du niveau de séparation, on constate souvent que l'ébauche des soies natatoires, le point noir à la base du cirre dorsal, etc. s'y développent plus intensivement que sur les autres segments.

Il semble que le phénomène de séparation soit dû à une compression
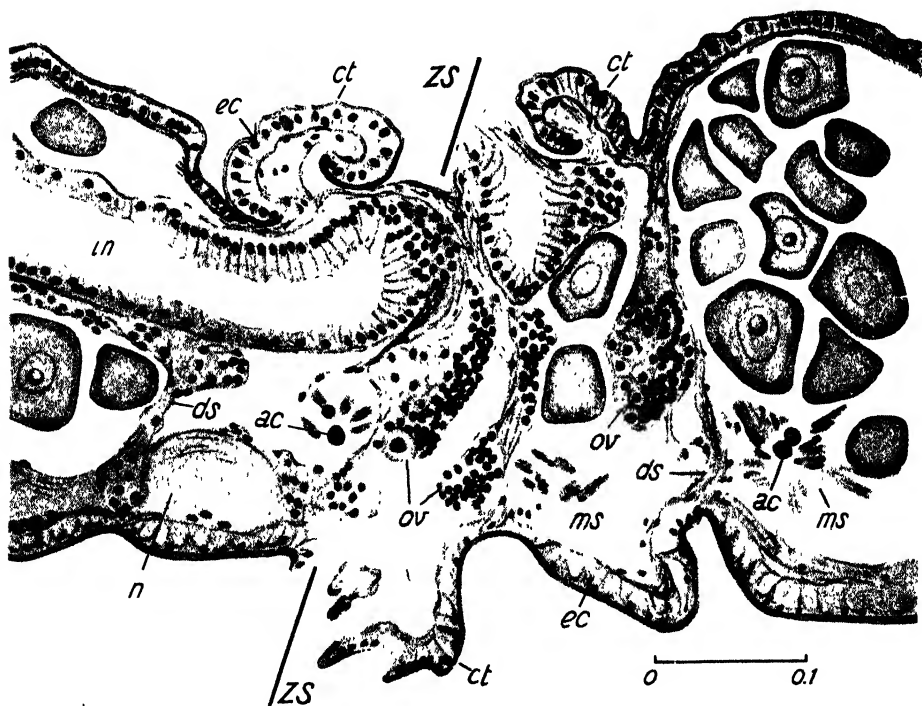
Fig. 2. *Haplosyllis spongicola*: Destruction de la paroi du corps au niveau de détachement du stolon (ZS).

antérieure et postérieure des éléments sexuels qui remplissent les segments de
la souche en avant et ceux du stolon en arrière de la position spéciale et aussi
à uń mouvement vibratoire continuel du dernier.   La division commence par
la rupture de la cuticule et de l'ectoderme de la face dorsale et provoque
l'exposition des organes internes (fig. 2).   La destruction des segments se propage
de la face latérale vers la face inférieure et la division s'achève alors.   Il
faut bien remarquer que le dissépiment est surtout parfait dans cette région
de division, tandis que les glandes génitales y restent en état rudimentaire ;
ce serait pour fournir des matières à la nouvelle production des segments qui
se manifeste après la séparation du stolon.   On voit que chez le spécimen
montré dans la figure 2, les trois segments représentant la région de division
sont agglomérés presque en un endroit, à cause de la compression des éléments
sexuels (des oeufs dans ce cas) contenus dans les autres segments qui les
précèdent et qui les suivent ; la rupture de la cuticule et de l'ectoderme de la
face dorsale y est nettement observée.

Le stolon est acéphale et possède de 15 à 23 segments sétigères et un
pygidium.   Outre la coloration des segments expliquée plus haut, la distinction
sexuelle du stolon s'observe souvent d'après le fait que chez le mâle la con-
stitution du corps est généralement plus légère et la métamorphose de segments
plus accentuée que chez la femelle, et que surtout le développement des néph-
ridies ne se rencontre que chez le premier.

Ce que je viens d'expliquer ci-dessus est un aperçu général sur la stolonisa-
tion chez la *Haplosyllis spongicola*.   La *Typosyllis cirropunctata* suit le même
mode de stolonisation.   Cette dernière espèce fut découverte à Naples par
Michel (1909), et depuis elle ne fut jamais trouvée ailleurs.   Cependant, il y
a quelques années, j'en ai obtenu quelques spécimens à Séto et observé deux
d'entre eux en voie de stolonisation.   C'étaient deux mâles : l'un de 17 milli-
mètres de long possèdait une tête, 88 segments sétigères et un pygidium, et
le stolon se formait entre les segments 65 et 66 ; l'autre un peu plus court
avait une tête, 74 segments sétigères et un pygidium, et la stolonisation était
en voie de manifestation entre les segments 60 et 61.   Dans ces deux cas, de
même que dans le cas de *Haplosyllis* précité, les segments du stolon se dif-
férenciaient nettement de ceux de la souche qui les précédaient, par la trans-
formation des parapodes en nageoires, le prolongement des soies natatoires,
l'apparition des granules pigmentaires dans l'ectoderme, etc.

J'ajoute ici que la *Typosyllis cirropunctata* japonaise, en comparaison du
type originel de Michel, est caractérisée par l'absence de taches pigmentaires
sur le dos ; il est certain que ces deux types sont d'une même espèce, n'ayant
pas d'autres différences entre eux.

Les stolons des deux types précités n'ayant pas de formation de tête, on
considère cette stolonisation comme primitive, mais si l'on traite cette question
en s'appuyant uniquement sur leur état au moment de la séparation, sans tenir
compte des changements futurs, on en trouvera la forme primitive plutôt chez
la *Typosyllis armillaris* rapportée par Malaquin (1893 p. 333).   Chez cette
espèce, à l'approche de l'époque de la reproduction, les segments postérieurs

contenant des éléments sexuels présentent une coloration caractéristique suivant les sexes et augmentent de volume en même temps ; la division est provoquée avant qu'ait lieu la transformation des parapodes en nageoires, constatée dans le cas précédent. Il va de soi qu'après la séparation du stolon le corps-souche reproduira les segments postérieurs perdus. D'autre part, la partie postérieure qui s'en est détachée entraîne aussi une régénération de tête après quelques jours de repos et elle est également suivie de métamorphose des segments y compris le changement des parapodes en nageoires et l'apparition des soies natatoires ; elle se développe ainsi en un individu nageur du type *Ioda*. Cependant, au moment de sa séparation, c'est nettement une division typique c.-à-d. une achitomie qui se réalise.

Alors, pourquoi la formation de tête dans le stolon détaché n'a-t-elle pas lieu chez la *Haplosyllis spongicola* ?

Comme il a été rapporté par l'auteur (Okada 1929 a p. 578), cette espèce même a vraiment la faculté de régénérer la tête, mais il semble que dans le stolon la métamorphose des segments soit trop intense avant sa séparation et qu'il lui soit impossible de vivre longtemps. Dans ces conditions, purquoi la formation de tête ne se manifeste-t-elle pas dans la région de division avant la séparation ? Cette dernière question revient en somme à chercher les causes de la paratomie chez la *Typosyllis prolifera* et chez d'autres espèces que nous allons décrire ci-dessous. Malheureusement, nous n'avons pas les documents nécessaires à l'éclaircissement de ces causes et nous nous bornons à affirmer ici qu'un stolon gravement atteint de changement des segments diminue de plus en plus sa faculté régénératrice et finit par la perdre complètement.

Chez la *Typosyllis prolifera* l'apparition des éléments sexuels est localisée dans la partie relativement postérieure du corps, par conséquent la région génitale et le nombre des segments destinés à se séparer s'approchent l'un de l'autre ; la partie

Fig. 3. Pièce médiane de *Typosyllis prolifera* avec la tête de stolon dans une position un peu en arrière de la limite antérieure des segments génitaux.

sexuée du stolon et la partie asexuée de la souche se distinguent. Il est bien entendu que ces deux parties ne sont pas strictement limitées ; pour la femelle

il reste presque toujours deux segments et demi génitaux en avant du niveau de division (fig. 3) et pour le mâle cinq ou six segments.

De plus, en comparaison du cas précédent, ce cas montre un grand progrès en ce que la tête se produit dans la partie postérieure et la queue dans la partie antérieure, avant que le stolon se détache de la souche, mais que, d'autre part, la métamorphose des parapodes et le développement des soies natatoires sont bien plus retardés ici que dans le cas de *Haplosyllis*; pour cette raison, le stolon détaché n'est pas encore apte à nager dans l'eau, au premier moment de sa séparation.

La différenciation sexuelle de cette espèce est pareille à celle de la *Haplosyllis*. La femelle présente un violet clair par la coloration des oeufs qu'elle renferme, et on voit chacun de ses segments s'épaissir beaucoup. Par contre, le mâle a une structure légère et accumule dans les parois du corps des granules pigmentaires d'un violet foncé; une paire de néphridies apparait nettement dans chaque segment. La structure interne de cette espèce est aussi à peu près semblable à celle de la *Haplosyllis*.

C'est le mode de reproduction des segments postérieurs qui est le plus caractéristique dans la stolonisation de cette espèce: une petite queue se produit à l'extrémité postérieure de la souche avant la séparation d'un stolon. Dans ce mode bien différent de celui de régénération caudale qu'on rencontre ordinairement, un demi-bourgeon de queue est formé à part à droite et à gauche, et leur soudure médiane ne sera jamais réalisée à moins que le stolon en arrière ne se sépare de la souche (figs. 4–10). En même temps que se produit
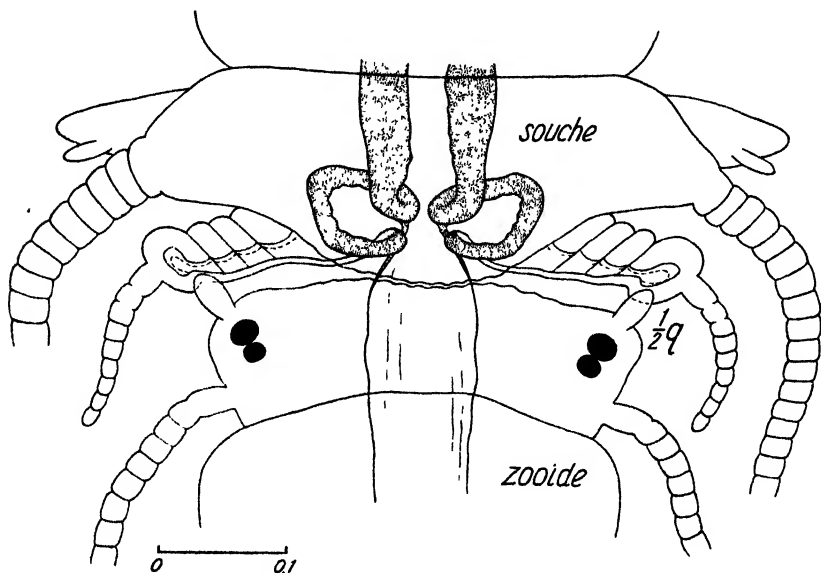
Fig. 4. *Typosyllis prolifera:* Tête du stolon et le segment de la souche la précédant en plus de magnificence; un demi-rudiment de la queue ($\frac{1}{2}$ q) est produit sur chaque côté de l'extrémité postérieure de la souche.

la séparation du stolon, les deux demi-bourgeons viennent se souder en se déplaçant de la face latérale vers la face ventro-médiane et former ainsi une queue complète.   Cette curieuse régénération caudale a été déjà rapportée par Michel (1909) et par moi (Okada 1929 a).   Le demi-bourgeon est dû à un accroissement latéral du dernier segment de la souche ; par conséquent, au début de son apparition, il n'est qu'un bourrelet des parois du corps, mais lorsqu'il s'est développé un peu, il forme une couche régulière de grosses cellules en face de la tête du stolon en arrière et quelques couches de cellules plus petites du bas en avant ; on voit se former de jeunes cellules mésodermiques indifférenciées entre ces deux sortes de couches ectodermiques (Okada 1929 a, fig. 6, p. 551).   La couche de grosses cellules en arrière de deux demi-bourgeons,
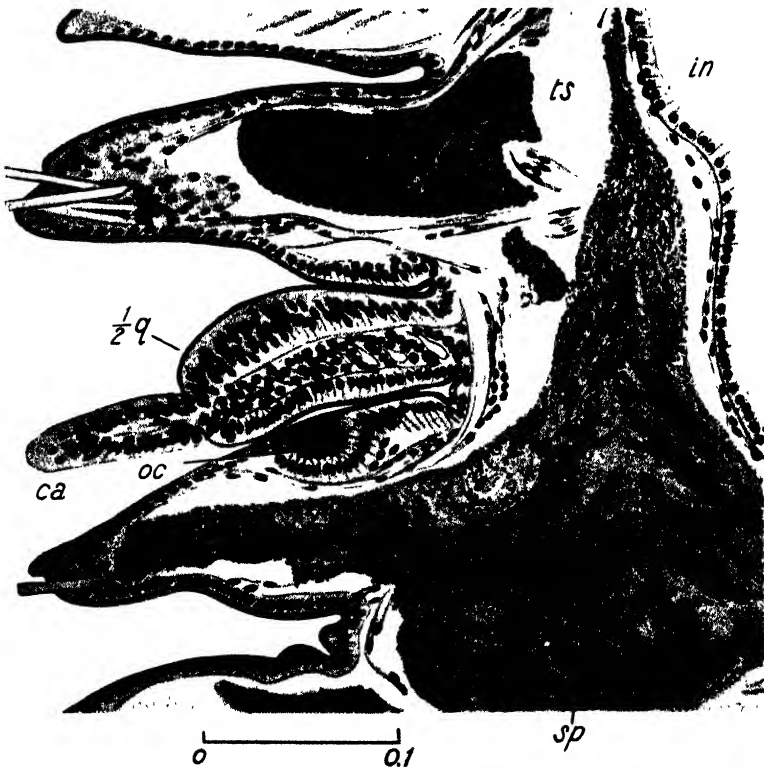
Fig. 5.   Moitié gauche d'une section horizontale de *Typosyllis prolifera* dans la position où se joignent deux individus, la souche en avant et le stolon en arrière ; le demi-rudiment de queue ($\frac{1}{2}q$) est montré en section longitudinale.

lorsque ceux-ci se soudent l'un à l'autre, formera l'intérieur des segments caudals et pourra se réunir avec le canal alimentaire de la souche.   Cependant, tout l'intestin de ces segments caudals nouvellement formés n'est pas toujours d'origine ectodermique.   Avant la séparation du stolon, l'intestin présente déjà dans la partie postérieure de la souche, un accroissement considérable vers

deux faces inféro-latérales (fig. 4), et avec la séparation du stolon, il est repoussé en dehors du segment en forme de hernie (fig. 8). C'est donc cette couche cellulaire qui participe à la formation intestinale de la queue en régénération, et la partie qu'on croit en effet d'origine ectodermique est limitée à une petite région relativement postérieure ; les cellules ectodermiques ne contribuent qu'à la formation du proctoderme, la grande partie du canal alimentaire étant toujours d'origine endodermique (figs. 8, 9, 11).

La soudure des deux demi-bourgeons de queue à droite et à gauche commence par la face ventrale en se dirigeant d'avant en arrière et elle est toujours retardée à la face dorsale ; surtout elle ne se produit jamais à l'extrémité postérieure et y laisse une fosse romboïdale qui deviendra l'anus de la nouvelle queue (figs. 9, 11). Quoique

Fig. 6. Section longitudinale de *Typosyllis prolifera* dans la même position que dans la figure précédente ; le demi-rudiment de queue ($\frac{1}{2}q$) est montré en la section transversale. *t*, tête du stolon.

le système nerveux soit formé séparément à droite et à gauche de l'ectoderme de la face inférieure de chacun des demi-bourgeons, il fait voir nettement sa différenciation remarquable après la soudure de ces derniers (fig. 10). La couche de cellules mésodermiques manifeste à l'intérieur beaucoup de segmentation depuis son apparition (fig. 5). Cependant, au moment de la séparation du stolon, on n'y voit que trois segments en outre du pygidium (fig. 7). La production des parapodes, des soies natatoires, des muscles, des glandes, etc. ne diffère point de celle qu'on constate dans la régénération en général (fig. 10).

Dans la stolonisation de cette espèce la formation de la tête du stolon est bien souvent localisée entre les segments 35 et 36 ou 36 et 37, comme le

tableau II le montre, mais ce niveau de division n'est pas très constant et ordinairement il s'avance plutôt dans la deuxième division que dans la première. Surtout lorsque l'extrémité céphalique est amputée à un ver en voie de stolonisation, on observe souvent qu'il reproduit la tête du deuxième stolon dans une région bien antérieure, avant de récupérer ses segments postérieurs perdus du fait de la séparation du premier stolon. Dans un cas extraordinaire, comme la figure 12 le montre, le ver formait déjà, avant de manifester une régénération postérieure, la tête
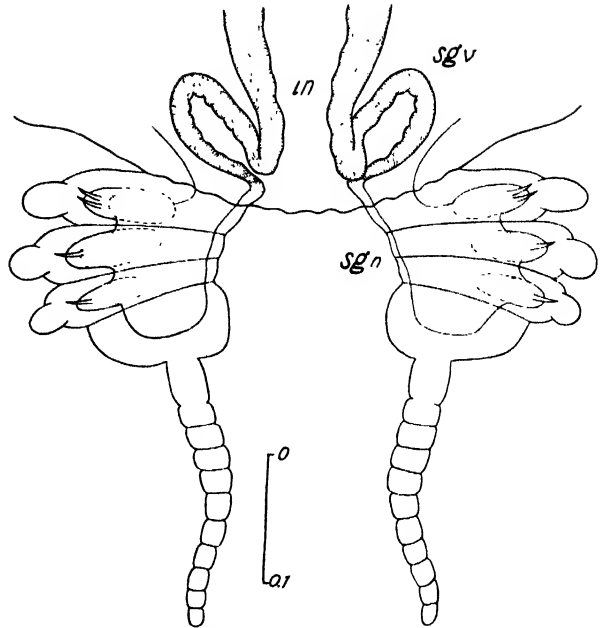
Fig. 7. *Typosyllis prolifera:* Le stolon est détaché et les demi-rudiments (latéraux) de queue sont déplacés vers la position postéro-médiane. Il y a 3 segments (*sgn*) dans chaque rudiment.
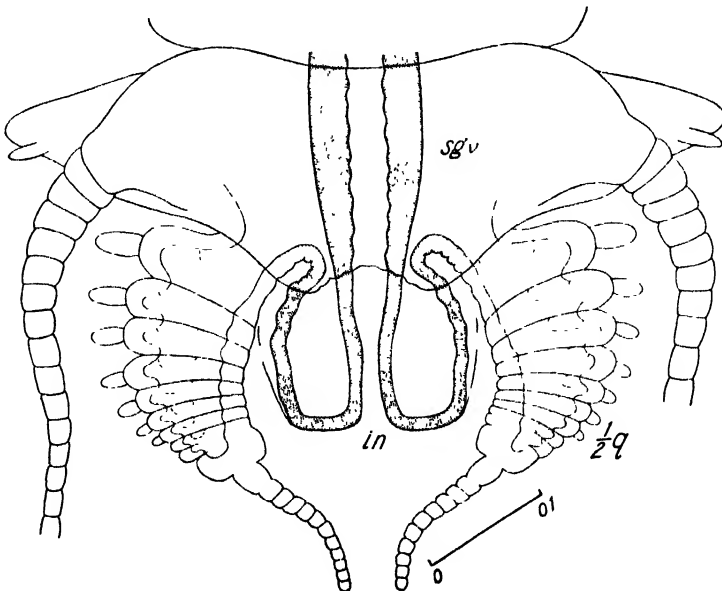
Fig. 8. Etat plus avancé de la régénération caudale de *Typosyllis prolifera* que dans la figure précédente. Il y a environ 10 segments sur chaque côté et l'extrémité de l'intestin (*in*) fait saillie à l'extérieur comme une hernie entre deux demi-rudiments de la queue.

du deuxième stolon à un niveau plus avancé de sept segments que celui de la division précédente et le stolon formé n'avait donc que les sept anciens segments.

⸍ Cependant, on ne doit pas croire que la région où se manifeste la formation de la tête de stolon s'avance outre mesure, et il est sûr qu'il y a une certaine limite, bien que je ne puisse pas préciser d'une façon certaine jusqu'à quelle région du corps est répartie la faculté de cette formation. Quand nous avons enlevé à un même individu six segments d'une région relativement anté-
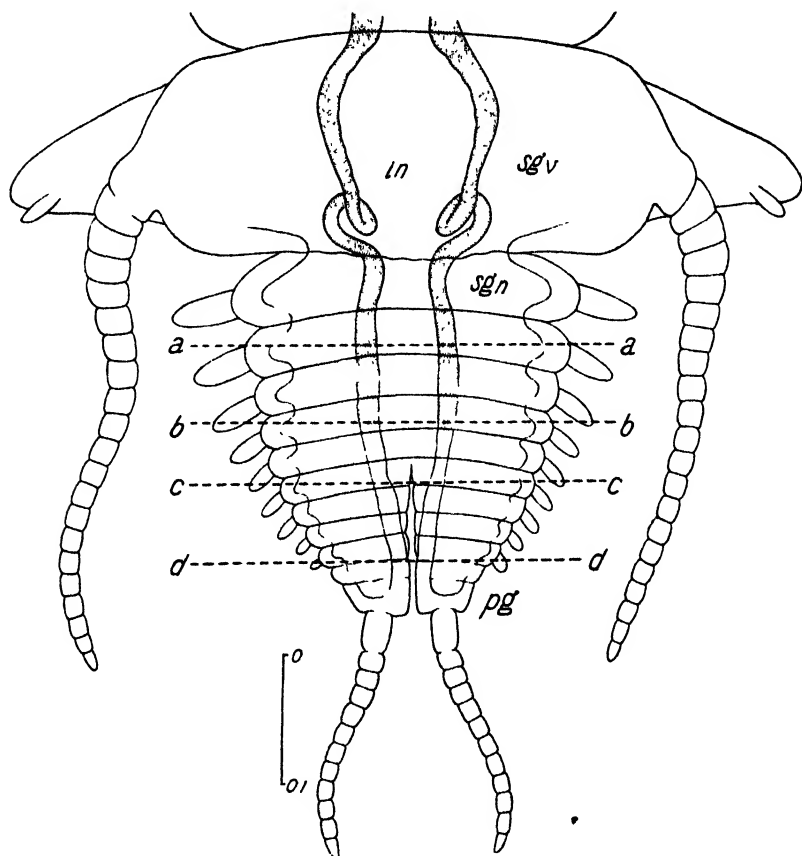
Fig. 9. *Typosyllis prolifera :* Les demi-rudiments de la queue se rapprochent l'un de l'autre sur la ligne médiane et la fusion a lieu alors d'avant en arrière.

rieure (: région plus reculée de quelques segments que le proventricule) et autant de segments de la région centrale du corps et comparé les états de régénération et de changement ultérieur de ces deux tronçons, chacun d'eux formait une tête en avant et six ou sept segments y compris un pygidium en arrière, au cours d'environ deux semaines après l'amputation c.-à-d. du 22 août au 7 sept. 1927. Et dans le tronçon enlevé de la région antérieure du corps, aucune tête de stolon n'apparaissait ni sur les nouveaux segments ni sur les anciens, tandis

que dans l'autre détaché de la région centrale la tête se formait entre les nouveaux et anciens segments. Nous pouvons en déduire que le niveau où se forme la tête de stolon est très variable mais qu'il est presque localisé dans la région centrale du corps.

De plus, et c'est le phénomène le plus étonnant dans la stolonisation de la *Typosyllis prolifera* que la formation de tête du stolon n'est pas toujours limitée dans un seul endroit et elle est parfois réalisée simultanément et aussi en chîne dans deux, trois ou même plusieurs segments. Dans un cas de stolonisation pluri-céphalique rapporté dans le travail précédent (Okada 1934), le ver ayant 20 mm. de taille et 60 segments environ, manifestait une formation de tête en chaîne sur les quatre segments successifs 45, 46, 47 et 48. Michel (1909) a rapporté un cas de *Typosyllis amica* où un fragment médian composé d'environ 38 segments formait, au moment de sa régénération, une chaîne de douze têtes de stolon du 2e au 13e segment ; mais il n'a rien dit de la régénération postérieure. D'après mes observations sur la *Typosyllis prolifera*, la régénération caudale est aussi entraînée en même temps, par conséquent les segments inter-
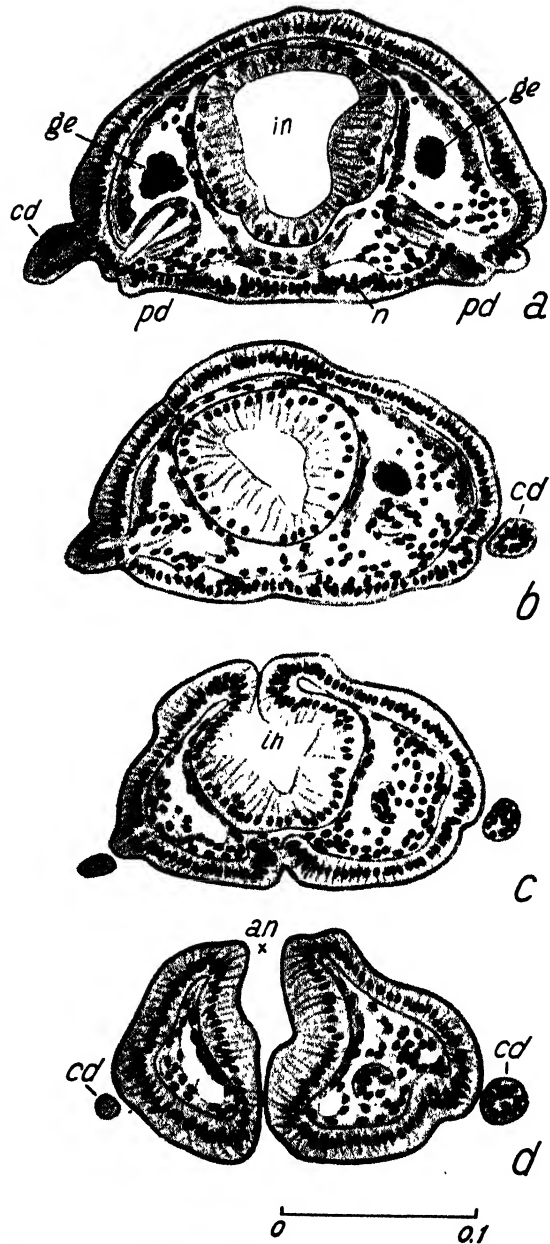
Fig. 10. *Typosyllis prolifera :* séries de sections transversales à différents niveaux de la nouvelle queue issue des deux demi-rudiments de la figure précédente ; *a* et *b* se trouvent à deux niveaux ou la fusion des demi-rudiments est complète. *c,* deux rudiments se sont juste rapprochés l'un de l'autre sur la ligne médiane, mais la fusion est encore incomplète. *d,* deux rudiments restent encore séparés l'un de l'autre.

médiaires forment chacun une tête en avant et une queue à l'extrémité posté-
rieure. La régénération caudale d'un segment est entraînée par formation de
la tête à l'extrémité antérieure du segment qui le suit, d'ailleurs il semble
qu'elle le soit surtout après que la tête a pris un certain développement. En outre, cette formation inductrice se produit indépendamment à droite et à gauche, par conséquent lorsque la formation de tête est limitée à un seul côté du segment, un demi-bourgeon de queue du segment qui le précède ne se forme également que de ce même côté, son partenaire n'apparaissant pas de l'autre.

Quoi qu'il en soit, le phénomène de la formation pluricéphalique chez les *Typosyllis prolifera* et *Typosyllis amica* paraît être à l'origine de la formation des stolons en file chez la *Trypanosyllis asterobia* que nous décrirons plus loin.

Chez la *Trypanosyllis zebra*, la régénération du corps postérieur de la stolonisation c.-à-d. la tête du stolon est un peu moins développée que chez la *Typosyllis prolifera*, mais celle de la souche en arrière, beaucoup plus avancée, forme déjà, avant l'indication de la tête, une paire de bourrelets sur la face ventrale de son dernier segment (fig. 13 a), et lorsque la tête du stolon

Fig. 11. *Typosyllis prolifera:* La formation de la queue médiane est maintenant complète après détachement du stolon et elle ne demande qu'à s'allonger davantage par l'addition de plus de segments. Dans les figures 4, 7, 8, 9 et 11, la partie endodermique du canal alimentaire est représentée par l'area pointillée.

s'aperçoit à peine, ces bourrelets forment déjà une queue médiane petite mais parafaite en s'unissant à la face ventro-médiane du segment (fig. 13 b).   Par conséquent, quand le stolon arrive à sa pleine maturité et se sépare, le régénérateur postérieur de la souche présente un allongement assez intense sous l'aspect d'une deuxième queue bifurquée vers le côté inférieur (fig. 13 c). Marion et Bobretsky (1875, p. 36), qui les premiers ont découvert cette formation de queue extraordinaire, l'expliquèrent ainsi : « Les demi-bourgeons

Tableau II

Tableau synoptique de la stolonisation chez la *Typosyllis prolifera*.

		1	2	3	4	5	6	7	8	9	10
Numéro des spécimens		1	2	3	4	5	6	7	8	9	10
Sexe		♀	♀	♀	♀	♂	♂	♂	♂	?	?
Limite antérieure des segments génitaux		33 me	33 me	34 me	35 me	36 me	39 me	46 me			
Nombre de segments génitaux dans la souche	6					• •	• •	• •			
	5					• •	• •	• •			
	4					• •	• •	• •			
	3	•	•		•	• •	• •	• •			
	2	• •	• •	• •	• •	• •	• •	• •			
	1	• •	• •	• •	• •	• •	• •	• •	?	?	?
Niveau de séparation; Entre les segments		35–36	35–36	36–37	38–39	41–42	45–46	51–52	58-59	35–36	42-43
Nombre de segments dans le stolon		18	19	25	17	21	18	17	10+R	R	R

• ou • • signifie la localisation des éléments sexuels en avant du niveau de division.

s'allongent ; viennent ensemble, se réunissent le long de leurs bords intérieurs, et se fondent dorsalement et ventralement, de façon à former une structure tubaire avec une cavité cylindrique. Cette cavité communique avec l'intestin de la souche et devient le canal alimentaire de la nouvelle queue qui paraît ainsi être formée d'ectoderme ». En ce qui concerne la formation du canal alimentaire, comme nous l'avons décrit dans le passage sur la *Typosyllis prolifera*, la couche ectodermique formant la face intérieure des demi-bourgeons est repoussée peu à peu en arrière par la couche endodermique de l'intestin qui y pénètre de la souche en même temps que se produit l'allongement de la nouvelle queue fusionnée ; en fin de compte, la couche ectodermique ne forme qu'une partie, postérieure, du canal c.-à-d. le proctoderme. Le canal alimentaire de la nouvelle queue est donc formé en grande partie d'un prolongement intestinal de la souche. Ce phénomène nous donne une base
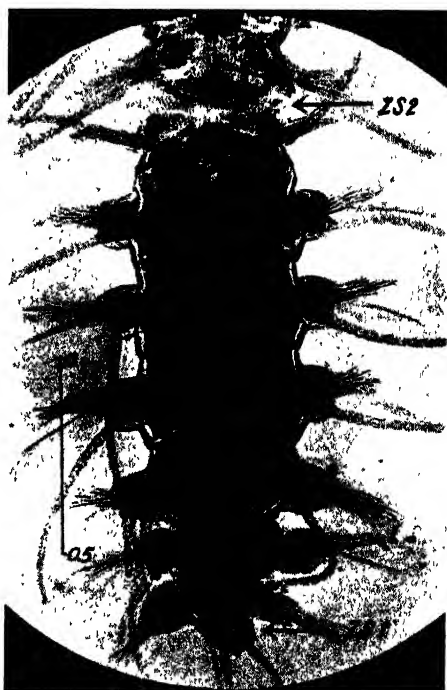
Fig. 12. *Typosyllis prolifera*: La stolonisation précède la régénération postérieure après détachement du stolon précédent ; le nouveau stolon consiste en anciens segments seuls. *zs1*, le niveau où le stolon précédent a été séparé ; *zs2*, le niveau ou le présent stolon se sépare.

fondamentale pour expliquer pourquoi les stolons perdent l'élément intestinal dans leur développement en file chez la *Trypanosyllis asterobia* que nous allons décrire ci-dessous et aussi dans le bourgeonnement dit collatéral chez les autres *Trypanosyllis* gemmipares.

Çe qui est le plus caractéristique de la stolonisation chez la *Trypanosyllis asterobia*, c'est que la régénération de la souche manifestée avant la séparation du stolon en forme de très bonne heure non seulement un second mais encore parfois quelques dizaines à la fois (cf. Okada 1933 a, fig. 4, p. 329 et figs. 1–4
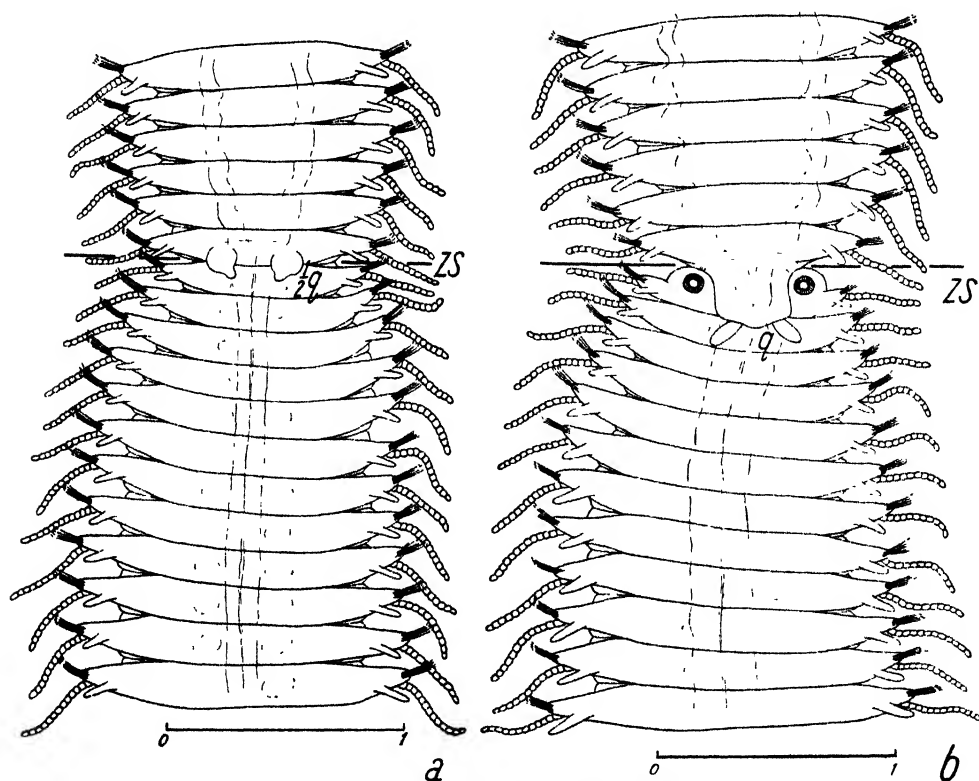
Fig. 13. Formation de la queue médiane chez la *Trypanosyllis zebra* avant détachement du stolon; *a*, la queue est représentée par une paire de demi-rudiments ($\frac{1}{2}$ *q*) qui en *b* se rapprochent l'un de l'autre sur la ligne médiane et la fusion a lieu (*q*).

sur la pl. XII). En comparant cette espèce à la *Trypanosyllis gemmipara* de Johnson et à d'autres espèces voisines au même mode de reproduction connu sous le nom de bourgeonnement collatéral, on constate que chez la *Trypanosyllis asterobia* chaque stolon est formé sur chaque segment et que le niveau de son apparition s'avance d'un segment suivant l'ordre ; par suite les segments correspondants au nombre des stolons contribuent à la formation des stolons, en avant de la région où s'est formé le premier. On peut considérer ce phénomène comme cas de régénération caudale du stolon achevée dans la
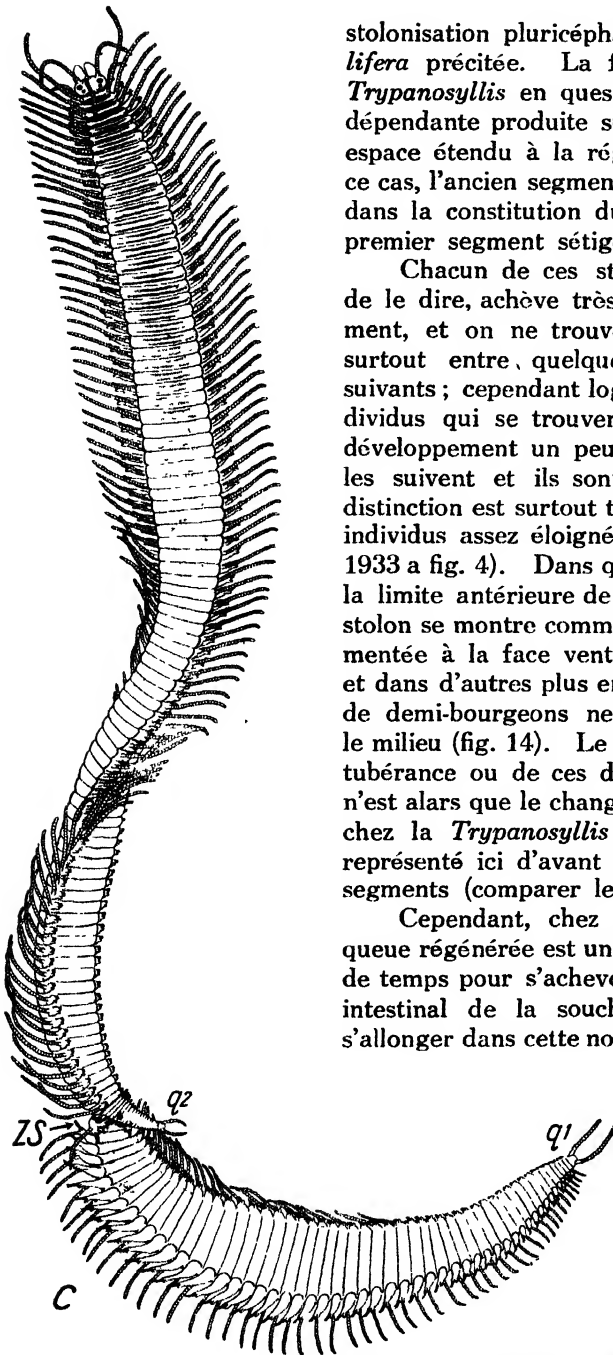
stolonisation pluricéphalique de la *Typosyllis pro-lifera* précitée. La formation du stolon chez la *Trypanosyllis* en question est une régénération indépendante produite sur chaque segment dans un espace étendu à la région de prolifération. Dans ce cas, l'ancien segment est donc toujours recueilli dans la constitution du stolon et forme ainsi le premier segment sétigère (fig. 15).

Chacun de ces stolons, comme nous venons de le dire, achève très rapidement son développement, et on ne trouve presque pas de différence surtout entre quelques individus précédents et suivants ; cependant logiquement et en fait, les individus qui se trouvent en avant ont toujours un développement un peu plus retardé que ceux qui les suivent et ils sont donc plus jeunes. Cette distinction est surtout très nette en comparant deux individus assez éloignés l'un de l'autre (cf. Okada 1933 a fig. 4). Dans quelques segments voisins de la limite antérieure de la région de stolonisation, le stolon se montre comme une protubérance non-segmentée à la face ventro-médiane du corps souche, et dans d'autres plus en avant, il n'est qu'une paire de demi-bourgeons ne se soudant pas encore par le milieu (fig. 14). Le développement de cette protubérance ou de ces demi-bourgeons en un stolon n'est alors que le changement évolutif d'une queue chez la *Trypanosyllis zebra*, changement qui est représenté ici d'avant en arrière dans de différents segments (comparer les figs. 13 a–d et 14).

Cependant, chez la *Trypanosyllis zebra*, la queue régénérée est unique et il lui faut beaucoup de temps pour s'achever ; par conséquent le canal intestinal de la souche a assez de temps pour s'allonger dans cette nouvelle formation ; par contre, chez la *Trypanosyllis asterobia* il produit très rapidement un grand nombre de queues à la fois et encore dans un espace limité, ne lui donnant pas le temps de la pénétrer. Il s'ensuit que sauf quelques premiers individus

Fig. 13 c. Formation de la queue médiane chez la *Trypanosyllis zebra* avant détachement du stolon; la nouvelle queue (q_2) atteint une certaine longueur et l'animal paraît avoir à la fois deux queues, une longue et une courte.

qui ont fait leur développement en un temps relativement long (figs. 16 a et 17 a), les autres, formés après eux, achèvent le leur sans intestin (figs. 16 b et 17 b). Or, comme il a été dit plus haut, le premier segment sétigère du stolon étant
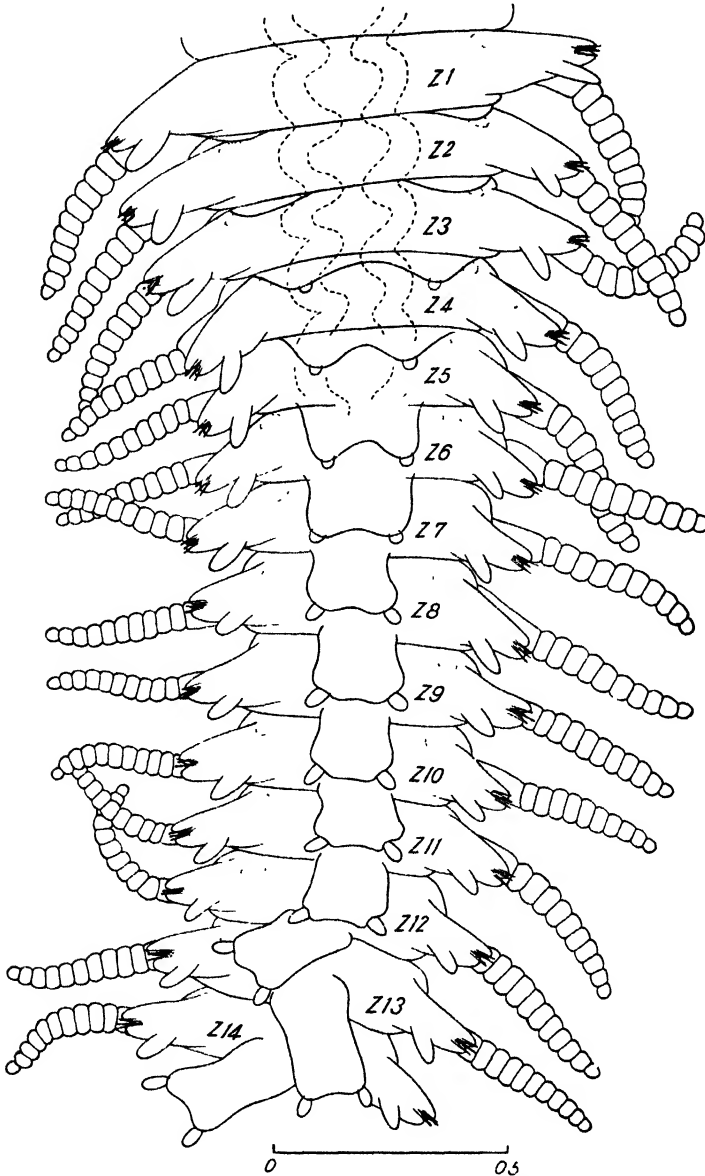
Fig. 14.   Première partie de la file des stolons chez la *Trypanosyllis asterobia,* le mode de stolonisation étant représenté par les stolons à différents stades de développe-ment et rangés en séries d'avant en arrière

celui de la souche, contient une partie de l'ancien canal alimentaire, mais le développement rapide et la séparation successive des stolons ne permettraient pas au canal laissé à ce seul segment de se développer dans un autre nouvellement formé ; ou bien, le canal ayant une taille trop courte serait privé du pouvoir de se prolonger suffisamment.

Le stolon détaché, d'après la forme du genre *Trypanosyllis* en général, est un type *Tétraglène* ayant une paire de gros yeux, mais par rapport à la *Trypanosyllis zebra*, l'extrémité antérieure de sa tête s'allogeant de deux côtés forme les tentacules latéraux (fig. 15). Il n'y a pourtant chez cette espèce aucune apparition des cirres tentaculaires qu'on remarque sur la tête du stolon de la *Trypanosyllis crosslandi* Potts, et au moment de sa séparation les soies natatoires sont très courtes ou souvent même invisibles. Le stolon a généralement une longueur de 10 mm. et possède presque toujours 42 segments sétigères et un pygidium (cf. Okada 1933 a, fig. 5, p. 330).

Fig. 15. Partie antérieure d'un stolon de *Trypanosyllis asterobia*, dont le premier segment sétigère est une inhérence de la souche-mère

Enfin, il est naturel que la formation des stolons chez la *Trypanosyllis asterobia* se fasse d'arrière en avant suivant un ordre fixe, mais son degré d'avancement étant presque insignifiant, elle paraît plutôt simultanée ou catastrophique. Comme il est remarqué dans la figure 2 sur la planche (Pl. XXIII) il y a une grande différence de stade entre les stolons en groupe produits par la première catastrophe et ceux formés par la seconde.

Fig. 16. *Trypanosyllis asterobia:* Sections longitudinales de deux types de stolon, dont *a* possède l'intestin et *b* n'en a pas. *in1*, intestin d'un ancien segment doté de la souche; *in2*, intestin développé dans les nouveaux segments du stolon.
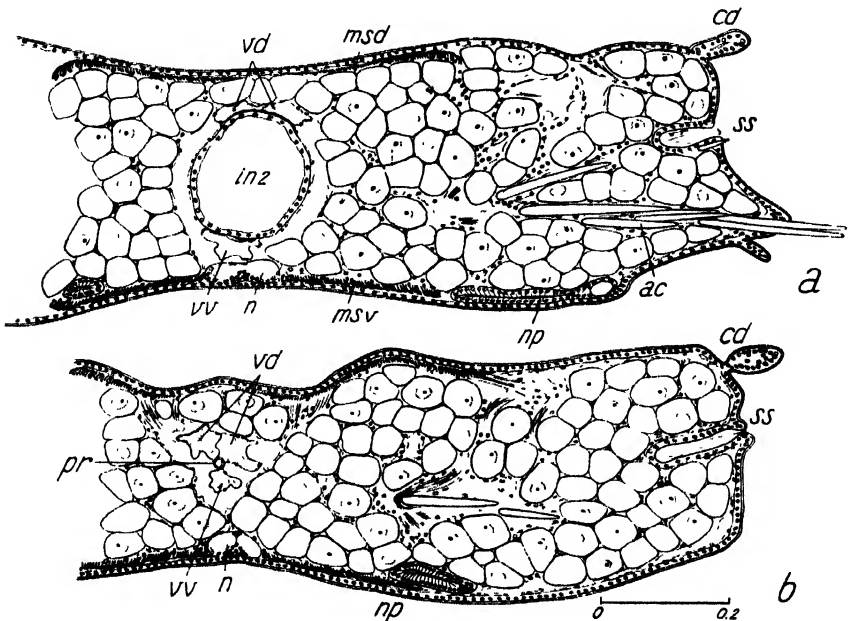
Fig. 17. *Trypanosyllis asterobia:* Sections transversales de deux types de stolon, comme il est montré dans la figure précédente, dont *a* possède l'intestin et *b* n'en a pas. *msd*, muscles longitudinaux du côté dorsal; *msv*, muscles longitudinaux du côté ventral; *pr*, péritoine en forme de tube; *ss*, base des soies natatoires.

Stolonisation gemmipare chez les *Trypanosyllis*

On soutiendrait volontiers que la file des stolons chez la *Trypanosyllis asterobia* provient d'une formation pluricéphalique qui se fait voir parfois chez la *Typosyllis prolifera* ou chez d'autres espèces voisines. Les autres *Tryoanosyllis* gemipares traînent aussi une rosette ou un faisceau de stolons formé à l'extrémité postérieure, mais il faut considérer ces deux cas comme tout à fait différents au point de vue de leur origine et du mode de développement des stolons. Le terme de « bourgeonnement collatéral » employé par Johnson (1901) pour ce type de stolonisation indique en effet un mode de formation des stolons, mais quant à sa signification, il faudrait y faire une objection. Le zoonïte formateur des stolons chez la *Tryponosyllis gemmipara* examinée par lui ayant été bien dévié vers la face latérale du segment de la région de prolifération, il a donné la dite désignation à cette formation des stolons en l'assimilant au bourgeonnement latéral chez la *Syllis ramosa* ; or, d'après la révision postérieure de Potts (1913) faite sur de nombreux cas, le zoonïte formateur en question se trouve généralement à la face ventro-médiane du segment de la région proliératrice, et c'est plutôt dans un cas exceptionnel qu'il dévie vers un seul côté comme Johnson l'a dit. Il serait donc raisonnable de croire que cette déviation est dûe à de nombreux stolons formés à la fois dans un espace très limité c.-à-d. dans un ou deux des derniers segments de la souche. Potts (l. c., p. 440) désigne la formation des stolons dans ce cas sous le nom de « bourgeonnement ventro-terminal », mais en tenant compte de la rangée des stolons produits, il conserve le terme de Johnson et cependant, dans la signification, il le distingue nettement du bourgeonnement latéral chez la *Syllis ramosa*.

Sans parler de la convenance ou non de cette terminologie, on peut énumérer les espèces suivantes comme prenant ce mode de prolifération : *Trypanosyllis gemmipara* de Johnson, précitée, *Trypanosyllis ingeus* (Johnson 1902), *Trypanosyllis misakiensis* (Izuka 1906) et *Trypanosyllis crosslandi*, décrite par Potts (1911). Ces quatre espèces sont plus ou moins différentes les unes des autres par leurs caractères spécifiques, mais il est dit qu'au moment de leur stolonisation un grand nombre de stolons apparaît toujours en groupe à la face ventrale d'un ou deux des derniers segments de la souche et que leur nombre atteint même plus de 50 (Johnson 1902, p. 303). Au cas où les stolons sont peu nombreux, ils diminuent nettement de grandeur d'arrière en avant et leur rangée n'est pas si irrégulière ; cependant, en raison du fait que l'espace de leur apparition est bien limité, les individus antérieurs et postérieurs ne s'entassent jamais sur la même face et s'entre-croisent à droite et à gauche en profitant du plus petit espace. On remarque aussi ce phénomène chez la *Trypanosyllis asterobia*. Quand de nombreux stolons se produisent à la fois, l'ordre de leur apparition n'est pas toujours d'accord avec l'axe antéro-postérieur du segment-souche et dessine tantôt une ligne oblique, tantôt une courbe semi-lunaire ; dans des cas extraordinaires, les stolons présentent une rangée spirale, mais alors cet ordre est conservé quand même et ceux qui se trouvent dans une position antérieure (: supérieure) ont toujours un développement plus tardif que ceux

qui occupent une position postérieure (: inférieure).

Des faits ci-dessus observés on peut déduire ce qui suit : la formation d'une rosette ou d'un faisceau de stolons par prolifération gemmipare chez ces espèces de *Trypanosyllis* peut être considérée comme répétition successive de la stolonisation simple chez le type primitif *Trypanosyllis zebra* où la queue produite de très bonne heure par la souche forme le deuxième stolon avant séparation du premier. Et, en tant que l'avancement du niveau de stolonisation qu'on constate chez la *Trypanosyllis asterobia* est impossible dans ce cas, il est tout naturel que de nombreux stolons soient groupés à la même place et qu'un zoonïte formateur y soit établi pour contribuer à la formation des nouveaux individus ; il paraît donc qu'il n'y a plus besoin de recourir aux anciens tissus pour la formation des stolons. L'alimentation par la souche est naturellement nécessaire à leur accroissement, tandis que la pénétration du canal intestinal y paraît moins indispensable. Reste la question de savoir dans quel état se trouvent les segments en arrière de la région de bourgeonnement, au moment de la formation du premier stolon. D'après Johnson (1902 p. 306), « ils resemblent beaucoup, comme aspect général, à ceux des bourgeons, et sont remplis des éléments sexuels qui font défaut à tous les segments de la souche situés en avant au niveau de stolonisation, mais ils en diffèrent par la possession d'un canal alimentaire bien cilié et d'un anus et par l'absence de céphalisation ». Par rapport à cet état de chose, deux questions s'imposent : la partie postérieure remplie d'éléments sexuels reste-t-elle jusqu'à la fin sans se diviser, ou devient-elle un stolon complet en formant tardivement la tête ? Lorsqu'on admet la première hypothèse, il paraît que chez cette espèce de *Trypanosyllis*, la formation des stolons prend uniquement le mode gemmipare, car la zone de prolifération est déterminée dès le début de la stolonisation. Or, d'après la description de Potts (1913), chez tous les spécimens de *Trypanosyllis crosslandi* la stolonisation se manifestait toujours à l'extrémité postérieure de la souche et il leur manquait la partie postérieure comparable à l'appendice génital de *Trypanosyllis gemmipara*. Par conséquent, quoique, chez cette espèce de Potts au moins, la partie postérieure ne constitue pas un stolon complet, il paraît qu'elle se sépare de la souche au cours du phénomène de bourgeonnement. D'autre part, Izuka (1906, p. 287) dit : « Chez la *Trypanosyllis misakiensis* le canal alimentaire du stolon est la continuation directe de celui du corps souche ; il est mince et se termine en anus du segment anal ». Autant que ses observations sont justes, il est probable que la partie postérieure du corps de l'ancien ver forme aussi un individu indépendant en procédant à la céphalisation.

En somme, soit que les segments suivant la région de prolifération se détachent de la souche, soit qu'ils ne s'en détachent pas, la stolonisation des *Trypanosyllis* se produit toujours à une distance fixe (: la longueur d'un stolon) de l'extrémité caudale, c.-à-d. à la face ventro-médiane du dernier segment de la souche ; bien entendu c'est parce que la régénération de la partie postérieure plus en arrière est répétée rapidement et maintes fois. En cas de prolifération particulièrement rapide, les stolons produits près du zoonïte formateur se mettent plutôt en rangées transversales, et tous les individus du même rang se trouvent

en même état de développement. On peut en supposer deux causes pour ceux du même rang : soit qu'ils se forment par division transversale d'un bourgeon, ou que les individus qui s'accroissent innombrablement en avant et en arrière, étant forcés de se ranger dans un espace très limité comme nous l'avons dit plus haut, produisent secondairement quelques rangées transversales en se fléchissant en zigzag, cependant que ceux du même rang, apparaissant presque en même temps, effectuent ainsi le même développement.

D'après mes observations expérimentales sur la *Typosyllis prolifera*, un demi-bourgeon de queue qui a perdu son partenaire ne forme jamais une queue complète (Okada 1934). En tenant compte de ce fait, il semble que la division du bourgeon soit impossible aussi dans ce cas. D'autre part, quant aux rangées centralisées ou spirales, Potts donne l'explication suivante : « Les stolons augmentent de longueur et de largeur, ceux qui se trouvent en dehors du rang sont expulsés vers le côté et le devant, à cause de la présence des rangs en arrière, de telle sorte que le rang prend la forme d'un croissant, et que la région de prolifération est en partie entourée de stolons en voie de développement. L'irrégularité doît se produire pourtant fréquemment par l'inégalité de croissance » (1913 p. 416). Enfin, les rapports entre le mode de prolifération par gemmiparité chez les *Trypanosyllis* précitées et celui par bourgeonnement latéral chez la *Syllis ramosa* seront mis en évidence en décrivant le bourgeonnement et la stolonisation de cette dernière espèce.

Stolonisation chez la *Syllis ramosa*

Le branchement étonnant du corps chez cet animal, signalé pour la première fois par McIntosh (1885), est toujours cité comme un cas extrême de mode de bourgeonnement chez les Annélides. D'après mes observations, ce branchement n'a aucun rapport de causalité directe avec la formation du stolon dont nous nous occupons ici maintenant et il doit être considéré, de sa nature, comme un phénomène tératologique. Si l'on veut en chercher une comparaison chez d'autres animaux, ce branchement serait équivalent à celui du bras de certaines Ophiurides. Une seule différence entre ces deux cas est qu'en cas de Syllide chaque branche a le pouvoir de former un individu c.-à-d. un stolon.

L'état où le stolon s'attache à une branche est décrit par McIntosh comme suit : — « Un pédicule de quatre segments étroits est intervenu entre la tête du stolon et le point d'attache de celui-ci au corps-mère ». Et sur les trois premiers segments du pédicule on ne voit ni tentacules ni parapodes, mais il est certain qu'ils sont indépendants les uns des autres quand on observe d'autres structures (cf. sa fig. 11, pl. 33). A ma connaissance, cet animal vit en parasite dans une éponge siliceuse, la *Crateromorpha meyeri*, qu'on trouve dans la profondeur de la mer de Sagami et manifeste sa stolonisation en été. Dans la stolonisation, les individus ne prennent pas naissance successivement les uns aux autres dans un même endroit, comme le cas des *Trypanosyllis* gemmipares, mais ils se forment à la fois en grand nombre sur les branches, à raison d'un stolon par branche. Par conséquent, il est douteux qu'il existe entre le stolon et la branche, comme

il a été décrit par McIntosh, un pédicule composé des segments peu nombreux et incomplets n'ayant ni tentacules ni parapodes.   Le nombre des segments existant entre le point de branchement et le stolon n'est pas toujours constant, et on peut dire qu'une tête de stolon apparaît au delà du nombre des segments qui sont suffisants pour former toute la longueur du stolon à partir de l'extrémité postérieure de chaque branche.   Quand on regarde donc à part chacune de ces branches, la stolonisation de la *Syllis ramosa* n'est autre qu'une simple schizogamie.   D'autre part, en comparant ce pédicule observé par Mc Intosh avec le pédicule non-segmenté apparu entre le stolon et la souche de la *Trypanosyllis gemmipara* (cf. Johnston 1902, p. 314), on constate qu'il n'existe entre eux aucun rapport de structure et d'origine.   Quant au degré de développement de la tête du stolon, ce n'est qu'un type *Tétraglène* dépourvu d'appendices, sauf l'apparition d'une paire d'yeux bien développés, comme l'a observé McIntosh.   Le stolon femelle remplit presque tous les segments d'oeufs ; chaque segment en est enflé.   Le mâle a le même développement de la tête que la femelle, mais la différenciation de ses segments sétigères s'avance d'un pas plus que l'autre : on y observe une métamorphose remarquable des parapodes en nageoires et le développement de soies natatoires bien prolongées. La production des spermatozoïdes est limitée aux huit premiers segments et les éléments sexuels font défaut aux autres postérieurs (fig. 2, pl. XXIII.).   Une telle différenciation des segments sétigères du stolon n'est jamais remarquée chez aucune autre espèce de la sous-famille Syllinae.   A ce point de vue, le stolon mâle de la *Syllis ramosa* présente une structure plus avancée que les autres Syllidés en général.   Chez les spécimens d'origine de Misaki, le stolon mâle possède généralement une longueur de 6mm. environ et est composé de 27 à 28 segments.

En examinant en détail le mode de branchement chez la *Syllis ramosa*, on en trouve deux cas : dans l'un le branchement est symétrique à droite et à gauche, et dans l'autre il est limité à un seul côté droit ou gauche.   Dans l'un et l'autre cas, la source d'un beurgeon se trouve toujours au niveau parapodial et jamais entre deux segments.   C'est Oka (1895) qui a donné des explications sur ce mode de branchement ; d'après lui, le branchement est provoqué par deux modes tout différents : « bourgeonnement intercalaire » et « bourgeonnement régénérateur ».   Les bourgeons qui suivent le premier sont symétriques pour la plupart et ils sont en rapport avec l'apparition d'un nouveau segment entre les deux anciens : à chaque côté du niveau où doivent se produire des parapodes et des cirres de ce nouveau segment, ils prennent naissunce, à leur place, comme de menus boutons.   Lorsque ces bourgeons ont un même développement, ils forment deux branches symétriques à droite et à gauche, et lorsqu'ils ont un développement différent l'un de l'autre, les branches qu'ils produisent ne sont plus symétriques, mais inégales.

Dans le branchement par bourgeonnement régénérateur, le cirre dorsal dégénère dans un côté des segments par une cause inconnue, et, selon mes observations, une masse cellulaire saillante, un peu opaque et distincte fait son apparition à la place de ce cirre, au niveau correspondant à sa base (fig. 18 a, *br*₁).   Et le nouveau cirre dorsal qui se reproduit à partir de cette masse à

la prochaine occasion est un peu plus gros que l'ancien et a à son extrémité une paire de cirres anaux très minces (fig. 18 br_2). Les parapodes qui se trouvent au bas du bourgeon régénérateur dégénèrent peu à peu avec le développement de celui-ci et finissent par disparaître complètement. Dans la phase suivante de leur développement, observée sur de nombreux spécimens, tous les bourgeons régénérateurs s'allongeaient et se segmentaient ; ils pré-
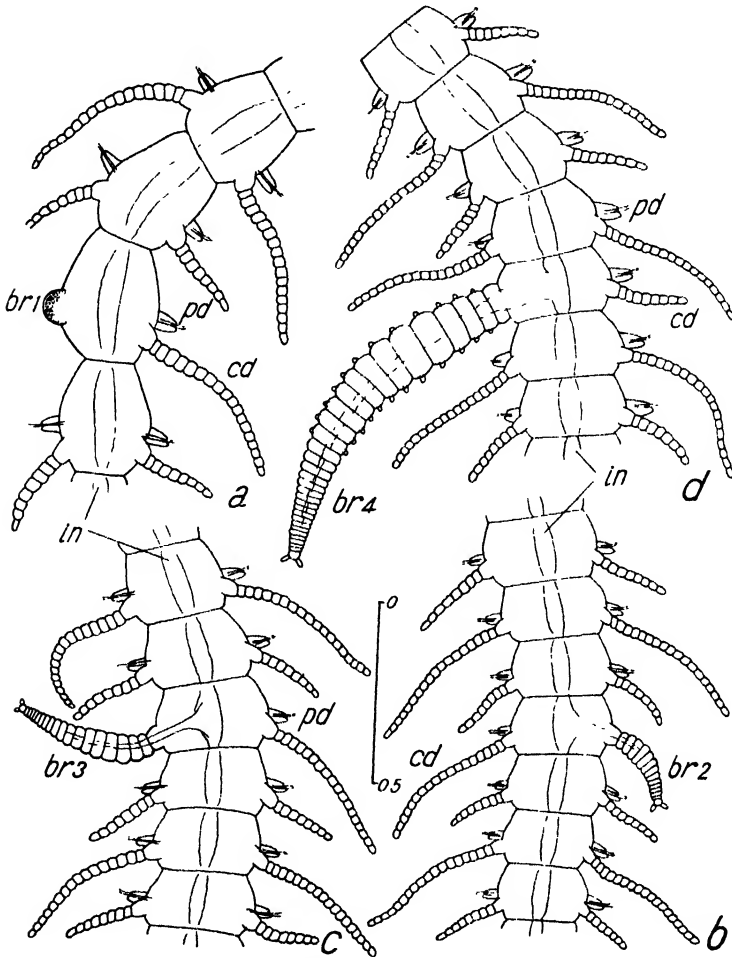
Fig. 18. Différents stades de bourgeonnement régénérateur chez la *Syllis ramosa*.

sentaient ainsi une forme suffisamment développée comme une branche indépendante et avaient un prolongement du canal alimentaire de la souche (fig. 18 c–d).

En somme, les deux modes de bourgeonnement en question ne diffèrent l'un de l'autre que par l'époque de la production des bourgeons, et dans les deux cas, le bourgeon peut être également considéré comme une transformation

du cirre dorsal.   Dans le bourgeonnement intercalaire, le parapode fait défaut
dès le début, tandis que dans le bourgeonnement régénérateur, il est peu à
peu absorbé et réduit à rien avec le prolongement du bourgeon régénérateur.
Pourquoi le parapode ne se produit-il pas dans le premier cas ? Chez les
Polychètes, au moins chez les Syllidiens, la formation du parapode est toujours
plus retardée que celle du cirre dorsal ; par conséquent, il paraît que lorsque
les bourgeons latéraux se produisent à la place des cirres dorsaux, le phénomène
de dégénérescence des parapodes qui suit cette production est compris dans
leur incapacité d'apparition.

En ce qui concerne la cause du bourgeonnement, Brunel et Schoener
(1904) disent qu'elle provient d'une plaie occasionnée par une aiguille aiguë de
l'éponge siliceuse où le ver vit en parasite. Mais alors, pourquoi deux modes
de bourgeonnement sont-ils provoqués par un même traumatisme ? Pourrait-
on en attribuer la cause à l'importance de la plaie occasionnée et supposer, par
exemple le bourgeonnement intercalaire dans le cas où elle atteint le canal
alimentaire et le bourgeonnement régénérateur dans le cas où celle qui est
donnée sur les parois du corps ne dépouille que le cirre dorsal ? Le branche-
ment latéral peut être provoqué par un traumatisme, comme Oka l'a constaté
sur un spécimen montré dans sa figure 4 : il a trouvé qu'une plaie donnée à
la queue d'un bourgeon en développement entraînait la formation d'une paire
de branches parallèles. Cependant, il n'est pas certain que la séparation des
stolons ou l'amputation du corps provoquée par d'autres causes soient toujours
le facteur du branchement. Il paraît que la régénération après séparation des
stolons produit plutôt la queue pour la plupart des cas. Mais le niveau
d'apparition des bourgeons régénérateurs, contrairement à nos expériences, se
trouve dans ce cas à l'extrémité postérieure au-dessus du canal alimentaire.
Ces bourgeons sont formés généralement au-dessous de celui qui est en contact
avec le nerf. Ce fait semble lié à ce que le branchement a lieu à la base du
cirre dorsal, et il est provoqué, au moins à son début, sans rapport direct
avec la chaîne nerveuse ventrale.

B. Stolonisation chez les Autolytidés

Le mode de reproduction asexuée chez tous les genres de cette tribu est
divisé en deux : stolonisation scissipare (schizogamie) et stolonisation gemmipare
(gemmiparité). La première est le cas où une tête se produit à un niveau du
corps et où les segments qui le suivent se séparent de la souche en devenant
un ver indépendant ; la seconde est le cas où non seulement la souche régénère
de nouveaux segments avant que le premier stolon s'en détache, mais
encore elle donne aussi d'autres stolons. Dans la première, la formation du
stolon est unique, tandis que dans la seconde une chaîne de stolons est souvent
formée. La formation des stolons en chaîne chez la *Myrianida pinnigera*
était considérée, jusqu'à la publication de mon travail en 1934, comme gemma-
tion terminale du dernier segment de la souche ; c'est parce que chez cette
espèce la schizogamie détachant un simple stolon ne se manifestait jamais et,

que le stade lui correspondant étant très court, passait immédiatement au stade suivant. Cependant en principe, cette formation ne diffère nullement de celle des stolons en chaîne chez l'*Autolytus Edwarsi* et chez d'autres espèces voisines de forme gemmipare.

En comparant le mode de reproduction de cette espèce avec le bourgeonnement ventro-médian des *Trypanosyllis*, on constate qu'il existe entre eux l'analogie que la régénération postérieure est particulièrement rapide et répétée à plusieurs reprises par la souche avant séparation du premier stolon ; cependant, il y a une grande différence entre eux en ce qui concerne la région de prolifération des nouveaux segments et la direction de leur développement : l'un provoque un faisceau et l'autre une chaîne de stolons.

Chez les *Trypanosyllis*, le tissu régénérateur apparaît d'abord dans une région ventro-latérale d'un segment qui se trouve dans la partie postérieure du ver, ensuite il passe au niveau ventro-médian, établit là un zoonïte formateur de stolons ; les stolons formés viennent se ranger presque verticalement à la face ventrale de la souche. Alors, cette région destinée à former des stolons étant trop limitée en espace, une modification secondaire intervient dans leur arrangement, mais elle n'exerce aucune influence sur la communication directe entre les segments non-sexués en avant et les segments sexués en arrière. Par contre, chez les Autolytidés, la zone de prolifération, comme en cas de bourgeonnement intercalaire chez la *Syllis ramosa*, apparaît entre la souche et le premier stolon ; d'autres stolons produits par suite de sa prolifération linéale engendrent un prolongement intercalaire avec l'augmentation de nombre des stolons et l'accroissement de taille de chaque stolon, et ils forment parfois une longue chaîne d'individus. De plus, dans ce cas, le canal alimentaire de la souche traverse le milieu de tous les stolons et atteint l'anus qui se trouve dans le dernier segment du premier stolon situé à l'extrémité postérieure. Cela va sans dire que le corps du ver se prolonge d'autant plus que les nouveaux segments interviennent entre la souche et le premier stolon. En somme, la différence entre ces deux cas extrêmes de gemmiparité dépend uniquement de ce que le premier bourgeon régénérateur se produit à un niveau ventro-médian de la souche ou de ce qu'il se forme entre un segment et un autre.

En étudiant maintenant la schizogamie simple à production d'un seul stolon chez les Autolytidés, on en trouve deux catégories différentes : l'une est un précurseur de la formation d'une chaîne de stolons et l'autre n'a aucun rapport avec la formation de cette chaîne. Il est caractéristique de la première que la structure du stolon est relativement simple et que, le niveau de sa formation n'étant pas constant pour la plupart des cas, est situé relativement en arrière du corps. Chez l'*Autolytus inermis*, lorsque le stolon se détache, on ne voit encore aucune formation de nouveaux segments à la souche, mais on peut se rendre compte par sa constitution et par le niveau de sa séparation (entre les segments 26–27 ou 30–31) que c'est le même type que la schizogamie simple apparaissant comme précurseur d'une chaîne de stolons.

C'est un fait bien connu que chez l'*Autolytus Edwarsi* et chez d'autres espèces voisines il se produit souvent la schizogamie à simple stolon tout à
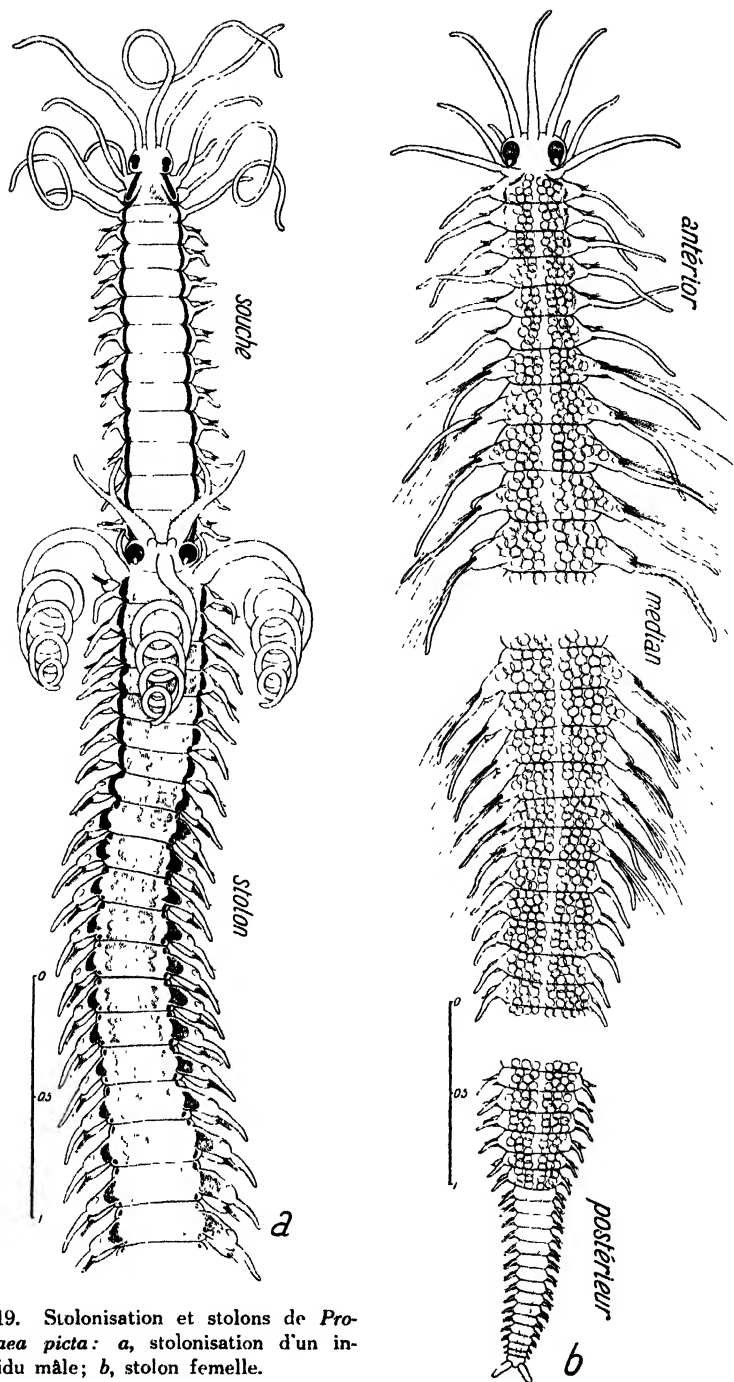
Fig. 19. Stolonisation et stolons de *Pro-
ceraea picta*: *a*, stolonisation d'un in-
dividu mâle; *b*, stolon femelle.

fait au début de la stolonisation. Dans ce cas-là, la région où apparaît la tête
du stolon n'est pas toujours constante, mais l'est quelquefois seulement ; dans
ce dernier cas, ce niveau se trouve toujours entre les segments 30 et 31 chez
quelques espèces connues jusqu'ici, chez l'*Autolytus purpureimaculatus* par
exemple (Okada 1933 a, p. 336). Quant à la position de la tête du stolon, j'y
reviendrai au moment de parler du zoonïte formateur qui se produit dans la
prolifération gemmipare.

La deuxième catégorie de schizogamie est caractérisée par le fait que la
position où apparaît la seconde tête est toujours fixée à la face antéro-dorsale
du 14e segment sétigère, et que, par rapport à cette formation antérieure, un
changement de structure se manifeste évidemment dans ce segment et aussi
dans les autres plus en arrière. Par exemple, une paire d'appendices plus
développés et ornant la tête sexuée, est en général une paire de cirres tenta-
culaires dorsaux nouvellement formés, mais parfois, comme chez les *Procerastea*
(fig. 21), une transformation directe des anciens cirres dorsaux qui garnissaient
le premier segment sétigère du stolon. En plus, on voit se produire quelque
modification aux cirres dorsaux du segment qui le suit. Ce qui est le plus
remarquable, ce sont les stolons de *Proceraea longeferiens* connue sous le nom
d'*Autolytus Alexandri* (cf. Okada 1929 a, figs. 30 et 31, p. 580). Et encore
dans cette seconde catégorie des stolons, le corps est divisé nettement en trois
parties antérieure, médiane et postérieure (figs. 19, 20, 21). La partie antéri-
eure, sauf les cas particuliers (*Autolytus Alexandri* et *A. roseus*, cf. Okada
1933 b, p. 641), se compose généralement de 6 segments non-modifiés et remplis
d'élément sexuels chez le stolon mâle. Les segments de la partie centrale en
arrière du 7e sétigère subissent une transformation des parapodes en nageoires
et se munissent de soies natatoires longues, quoiqu'il y ait assez de différence
suivant les espèces et les sexes. Le nombre des segments qui se transforment
n'est pas fixe dans cette partie. On ne voit pas de métamorphose de segments
dans la partie postérieure. Parmi les espèces qui forment les stolons d'une
différenciation si élevée et effectuent la séparation entre les segments 13 et 14,
on peut compter, en dehors de la *Proceraea* établie par Ehlers, deux autres
genres : *Procerastea* et *Virchowia*. Il y a encore une espèce qui produit, au
point de vue de sa constitution, un stolon appartenant plutôt à la première
catégorie, c'est la *Proceraea cornuta*. Cette dernière espèce vit habituellement
sur les côtes orientales de l'Amérique du Nord, mais elle se trouve également
depuis 1929 à Plymouth en Angleterre (Okada 1933 b, p. 645). Beaucoup plus
petite que les autres du type *Proceraea* d'Ehlers, elle ne possède que 40 à 45
segments et rarement 50. A ce point de vue, cette espèce ressemble au type
Autolytus de Grube ; de plus, la structure de tête du stolon et l'état de méta-
morphose des segments ressemblent presque entièrement à ce dernier (cf.
Okada l. c., fig. 3, p. 645). Cependant, la stolonisation étant toujours unique
se manifeste entre les segments 13 et 14, et la partie antérieure non-modifiée
du stolon se compose de six segments. C'est par là que cette espèce peut
être classée dans la deuxième catégorie de schizogamie des Autolytidés. De
plus, dans les stolons femelles les segments sétigères se divisent nettement en

trois parties, antérieure, médiane et postérieure.

La *Virchowia clavata* est aussi une petite espèce ne possédant qu'une tête, 40 segments sétigères et un pygidium, mais la stolonisation se produit toujours entre les segments 13 et 14 ; on observe sur le stolon d'abord 6 segments non-modifiés, ensuite environ 20 segments postérieurs manifestant la transformation des parapodes en nageoires, on remarque enfin que les suivants restent sans subir aucun changement et constituent la région postérieure non-modifiée (fig. 20). A ce point de vue, la formation du stolon est ici plus compliquée que celle de la forme précédente. D'autre part, chez cette espèce une paire d'appendices nucaux saillants est bien développée sur la tête et aussi sur celle du stolon nouvellement formé; cependant, les ornements latéraux de la tête du stolon ne sont qu'une paire de cirres tentaculaires dorsaux du segment nouvellement formé, comme dans le cas précédent et aucune influence de la céphalisation n'est remarquée sur les autres segments postérieurs.

Fig. 20. *Virchowia clavata :* Stolonisation et stolon chez l'individu mâle.

Malaquin (1892, p. 321) écrit que chez la *Procerastea Halleziana* le prolongement du corps est entraîné par l'intercalation des nouveaux segments dans la région centrale avant la stolonisation, mais c'est une erreur due à l'insuffisance de ses observations ; il a confondu avec la stolonisation le phénomène de régénération qui se manifeste après fragmentation du corps. Les phénomènes qui le suivent ont

été bien mis en évidence par le travail d'Allen (1921). Quant au mode de stolonisation de cette espèce au moins, il ne diffère point de celui des Autolytidés du type *Proceraea* cité plus haut. Ce qui le caractérise est que dans tous les segments du corps, sauf la tête et le premier segment sétigère, les cirres dorsaux sont rudimentaires (ils n'apparaissent, des deux côtés des segments, que comme des mamelons peu saillants et relativement transparents), s'allongent plus ou moins au moment de la stolonisation et se développent en tentacules parfaits suivant les régions. C'est le 14e segment qui contribue directement à la céphalisation du stolon representant le premier segment sétigère de ce dernier et les autres segments postérieurs, excepté les 5 segments du 15e au 19e (voir fig. 21). Cependant, il est à remarquer que chez les mâles la métamorphose des parapodes est parfaite, tandis que le développement des cirres dorsaux sur ces segments modifiés de la partie centrale n'est pas si complet que chez les femelles (fig. 21 a). Il leur faudrait une nutrition considérable pour la transformation des parapodes en nageoires.

Nous nous sommes bornés à observer ci-dessus certains cas de schizogamie chez les Autolytidés.

Fig. 21. Stolons mâle *(a)* et femelle *(b)* de *Procerastea Halleziana.*

Nous tenons à y ajouter pourtant quelques mots : lorsque la régénération à partir de la souche, qui se manifeste successivement par gemmation est retardée jusqu'au moment de la séparation du stolon, il est impossible d'établir une

différence de mode et de structure, sauf concernant les caractères d'espèces, entre ce cas de régénération supprimée et le cas de vraie schizogamie. Pour cette raison, il est naturel que leur distinction n'ait pas été établie jusqu'ici, mais en les comparant en détail, on arrivera à une distinction que nous venons de faire : l'un n'a aucun rapport avec la gemmiparité et l'autre se trouve dans la position la plus primitive de la phase se développant selon la gemmiparité.

En amputant un spécimen d'*Autolytus Edwarsi* qui ne présente encore aucun signe de stolonisation de son extrémité antérieure, on peut provoquer facilement l'apparition d'une seconde tête dans un segment de la partie médiane du corps et y entraîner une schizogamie. Il va sans dire que le stolon formé se détache de la souche, mais ce détachement est généralement précédé de la formation d'une queue à l'extrémité postérieure de celle-ci (fig. 22 *pg*). La partie ainsi régénérée peut être comparée à la régénération postérieure chez les *Typosyllis prolifera* et *Trypanosyllis zebra*, bien qu'il y ait certaines différences de structure. Par contre, chez les *Proceraea*, *Procerastea* et *Virchowia* qui se reproduisent toujours par schizogamie, quoique la tête ait un développement bien avancé au moment de la séparation
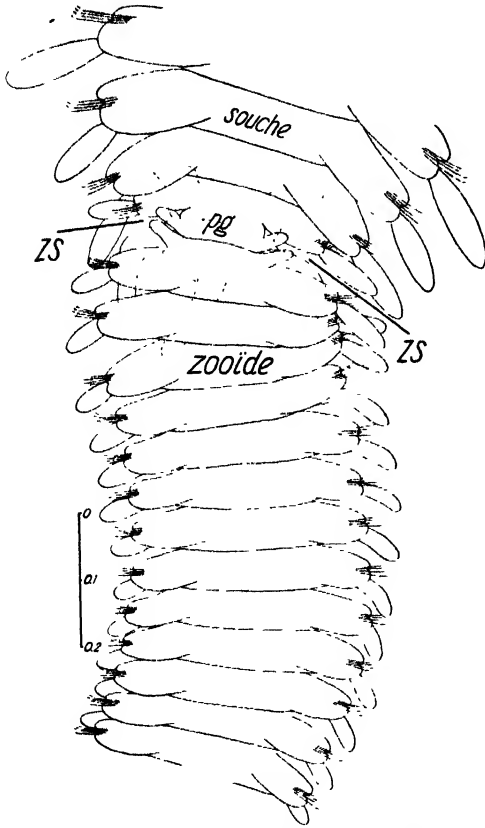
Fig. 22. Schizogamie d'*Autolytus Edwarsi* artificiellement provoquée par une coupe dans la partie antérieure du ver, vue ventrale.

du stolon, et que le stolon s'attache longtemps à la souche, on ne voit jamais de nouveaux segments de queue se former dans celle-là avant la séparation. La régénération se réalise toujours après que le stolon s'est détaché de la souche.

Gemmation chez les Autolytidés

Il serait superflu de répéter ici que la régénération se manifeste déjà dans la souche avant que le premier stolon s'en détache et procède de suite à la formation du second et produit successivement, avant l'achèvement de celui-ci, les stolons 3, 4, 5, etc. Sans distinction de genre, *Autolytus* ou *Myrianida*,

la tête du stolon apparaît dans un segment éloigné d'une certaine distance de l'extrémité postérieure du ver, et avant qu'elle ait complété son développement, un nouveau segment est formé par bourgeonnement à l'extrémité postérieure de la souche ; à la suite de l'accroissement rapide et de la segmentation de celui-ci se produit le deuxième stolon.   Quand ce mode de régénération des nouveaux segments et la formation du stolon se répètent rapidement et successivement, un grand nombre de stolons font leur apparition.   A ce moment, le premier segment qui se lie directement à l'extrémité postérieure de la souche constitue le zoonïte formateur d'une chaîne de stolons pour son rôle dans l'avenir.   Quant à la formation de nouveaux individus, on trouve les observations de Malaquin (1892) sur les *Autolytus Edwarsi* et *Myrianida pinnigera* et les études de Mensch (1900) sur l'*Autolytus variens*, mais ils n'y traitent pas d'une façon suffisante de leur première segmentation.   Le segment qui se forme d'abord comme zone de prolifération est une régénération à bourgeonnement destinée à récupérer les segments postérieurs perdus de la souche, et le mode de son développement doit suivre la règle générale de la régénération de la queue (Okada 1929 a, p. 543).   Et, suivant cette règle, la première segmentation sépare une zone de croissance en avant d'un pygidium arrière.   Cependant, lorsque de
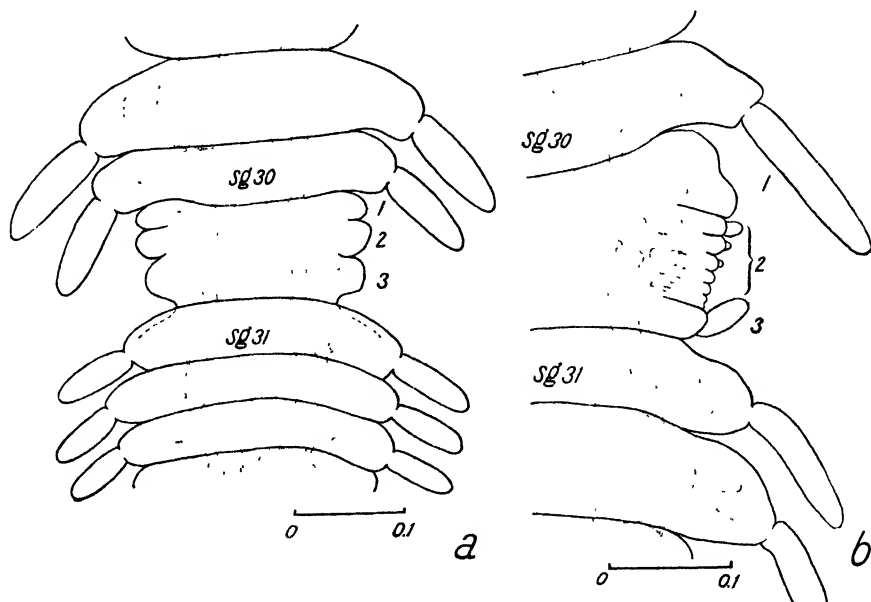
Fig. 23.   Segmentation du segment intercalé au début de la gemmation d'*Autolytus Edwarsi* ; *a*, la première triple division du nouveau segment. *b*, Etat plus avancé du mode de gemmation où est bien établi le second stolon.

nombreux segments se forment rapidement comme au moment de la stolonisation gemmipare, cette segmentation se divise généralement dès le début en trois parties (fig. 23 a).   Dans ce cas, le segment le plus rapproché de la souche reste

comme source de production des stolons en chaîne et les deux autres suivants participent directement à la formation d'un nouvel individu ; d'ailleurs, le dernier segment est destiné à former le pygidium de celui-ci. Le segment du milieu est subdivisé de suite en deux parties : la première forme le premier segment sétigère d'un nouvel individu et la seconde la zone de naissance des segments restants. Le premier segment sétigère produira plus tard une tête sur sa face antéro-dorsale, tandis que le zoonïte formateur formera successivement d'autres segments qui suivent le premier, et il gardera toujours sa place primitive qui se trouve immédiatement en avant du pygidium (fig. 23 b). Par conséquent, c'est à juste titre que Malaquin a divisé bien distinctement la formation d'une chaîne de stolons chez la *Myrianida pinnigera*, en désignant le segment, source
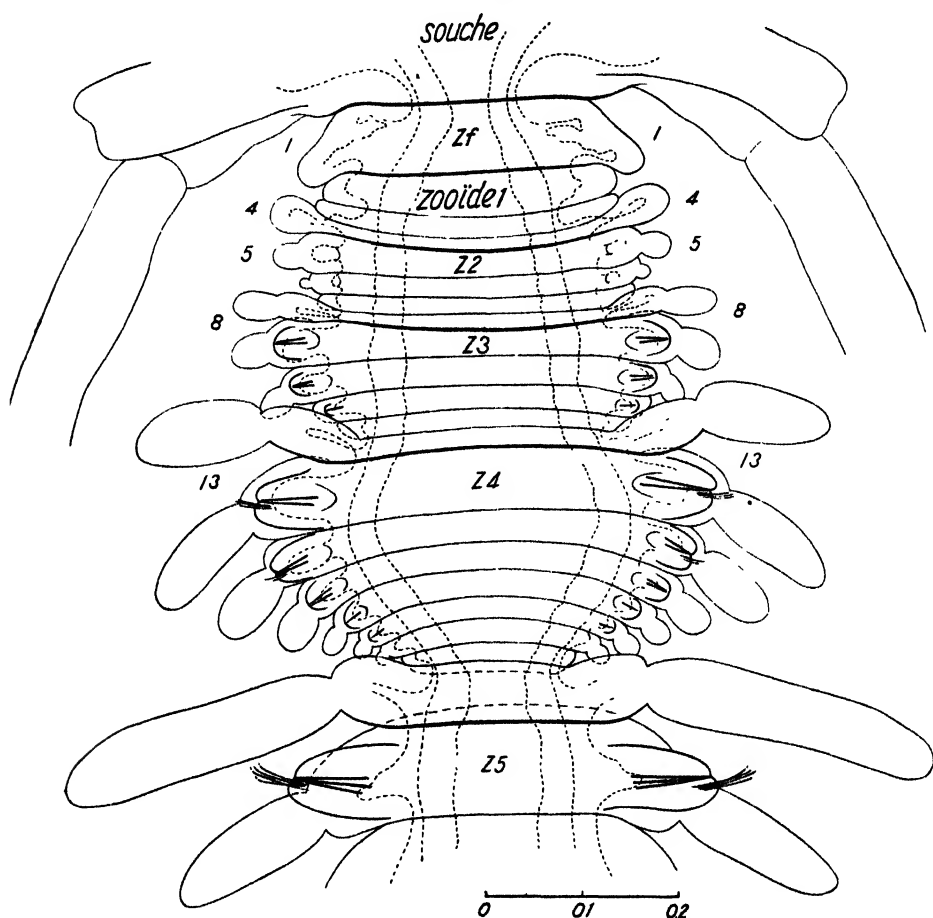
Fig. 24. Première partie de la chaîne des stolons chez la *Myrianida pinnigera*.

des stolons en chaîne, sous le nom de « zoonïte formateur de chaîne » et celui qui fait la source des segments d'un individu sous le nom de « zoonïte forma-

teur de stolon individuel ». Or, après lui, Potts (1911, p. 38) a fait une erreur indéniable en comprenant dans le zoonïte formateur de chaîne ces deux segments situés immédiatement après la souche. Il est clair que le segment qui suit immédiatement la souche, montré sur la figure 10 de Malaquin (l. c., p. 292) est la zone de prolifération des stolons en chaîne, mais le segment suivant doit être considéré comme le premier segment sétigère d'un nouvel individu. Dans ces conditions, il est naturel que les deux segments suivants c.-à-d. Zf' et As sur la figure 12 de Potts (l. c., p. 39) forment ensemble un individu, St. 1. (Il faut référer à la fig. 24).

Mensch (1900, p. 277) a donné sur le processus embryonnaire de l'*Autolytus variens* une opinion differente et que voici : — « La région embryonnaire de cette espèce consiste en 5 segments, dont les deux antérieurs sont d'une taille égale et, étant les plus jeunes de la série, peuvent être considérés comme segments embryonnaires typiques. Ces deux segments sont bien plus petits que ceux de la souche et ne présentent aucun signe de parapodes. Les autres 3, 4 et 5, sont légèrement plus avancés en développement et forment sur chaque côté une petite papille qui paraît être un parapode rudimentaire ». Cet auteur a désigné, d'une façon générale ces 5 segments du nom de segments embryonnaires, mais il n'a rien dit du segment qui faisait la source du bourgeonnement des stolons et de ceux qui participaient à la formation du plus jeune stolon. Encore ici, des deux segments considérés comme segments embryonnaires, le premier seul, qui est le plus rapproché de la souche, serait le zoonïte formateur de la chaîne et les autres auraient déjà participé à la formation du plus jeune stolon. Cependant, ce qui m'embarrasse beaucoup ici, c'est qu'il y avait déjà apparition des cirres dorsaux sur les trois segments suivants. Me basant sur mes expériences obtenues chez les *Autolytus Edwarsi* et *Myrianida pinnigera*, et surtout considérant les description de Mensch comme exactes, je voudrais établir une série du plus jeune individu avec le dernier des deux segments privés de papille dorsale et le premier des trois autres qui les suivent ; dans ce cas-là, le premier pourrait être considéré comme un type ne se segmentant pas encore en premier segment sétigère et en zone de croissance et le second comme représentant le pygidium de cet individu. Il serait alors très naturel qu'on y constate l'apparition d'une paire de cirres anaux. Venons maintenant à la signification des deux segments 4 et 5 pourvus de papille dorsale. Si on les unit aux deux segments sétigères 1 et 2 du stolon suivant, il leur manquera deux segments représentant la zone de croissance et la pygidium. En observant en détail sa figure 6 sur la planche 13, on constate que la tête fait déjà son apparition nette dans le stolon suivant ; les deux segments en question ont échappé aux observations superficielles de l'auteur américain, probablement à cause de leur inclination vers le bas. En effet, Mensch a dessiné sur la figure 7 un jeune stolon à quatre segments, dont le 1er et le 2e avaient une paire de papilles dorsales, le dernier les cirres anaux pareils et l'autre situé entre eux était privé de papilles. D'après lui, ce dernier prend naissance au segment anal et n'a aucun rapport avec le deuxième segment qui précède ce pygidium, mais cette opinion est contraire à la règle générale de
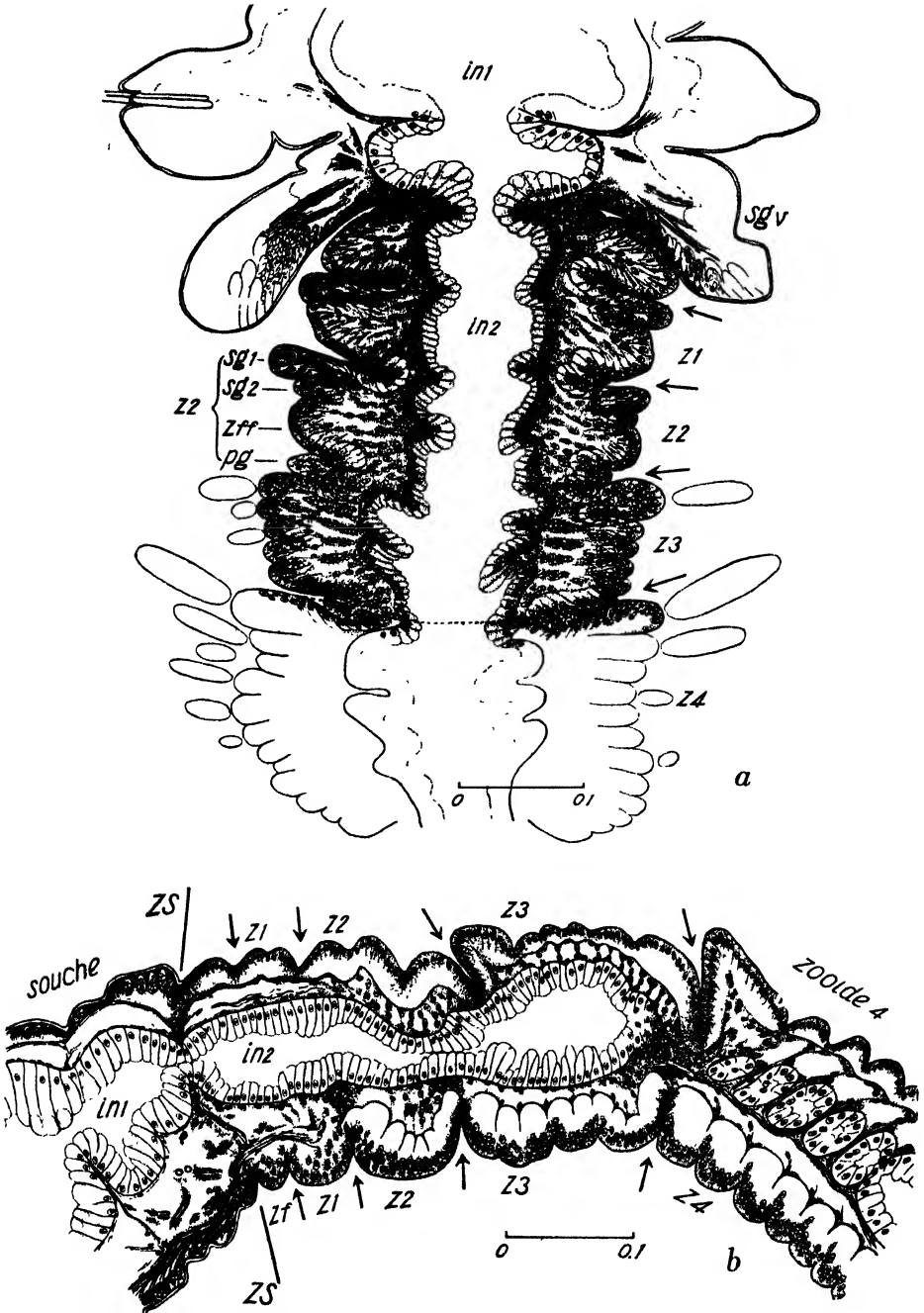
Fig. 25. *Autolytus Edwarsi:* Première partie de la chaîne des stolons dans les sections
horizontale (*a*) et longitudinale (*b*). *in1*, canal alimentaire de la part de la souche;
in2, celui de la part des stolons.

la formation de nouveaux segments chez les Annélides Polychètes en général, et loin de trouver ses partisans.

POSITION DE LA STOLONISATION

Chez les *Proceraea, Procerastea* et *Virchowia,* la position où est formée la deuxième tête au moment de la stolonisation est toujours déterminée à la face antéro-dorsale du 14e segment sétigère, indépendamment du nombre des segments qui constituent toute la longueur du ver. Grâce à cette détermination caractéristique, comme l'auteur l'a décrit dans une étude précédente (Okada 1934), lorsque la division a lieu sur un seul côté d'un des segments qui précèdent le 14e, et que le nombre des segments est différent à droite et à gauche en comptant à part, une formation céphalique se produira sur chaque segment correspondant au 14e en comptant à partir de la partie antérieure du corps et un stolon à double tête y sera ainsi provoqué. Cependant, quoiqu'on déduise un certain nombre de segments en faisant expérimentalement une amputation antérieure, il est impossible de déplacer d'autant en arrière la position déterminée de la formation de tête du stolon.

Chez les *Myrianida* et *Autolytus* gemmipares, la position où se produit la tête du stolon est parfois très variable ; par suite celle où apparaît la chaîne des stolons l'est également ; mais comme l'auteur l'a dit dans l'étude sur la *Myrianida pinnigera* (Okada 1935, p. 97), cette position ne fait pas de déplacement continuel dans les segments successifs et elle est plutôt fixée dès le début. A ce point de vue, la position en question est bien différente chez les Autolytidés et les Syllidés. Chez les dernières, le déplacement de cette position se manifeste parfois successivement dans plusieurs segments ; lors même qu'il a lieu avec interruption comme chez les premières, la position n'est jamais fixée dès le début.

D'après mes observations sur la *Myrianida pinnigera,* la position la plus antérieure où apparaît la chaîne des stolons se trouve immédiatement après le 34e segment (1)* et aussi dans les suivants : 37e (1), 40e (4), 44e (6), 48e (6), 52e (7), 56e (11), 60e (7), 64e (5), 67e (0), 70e (0), 73e (0), 76e (1). En comparant ces positions à celles de division du corps indiquées par la formule de fragmentation de cet animal : H13 3 3 3 4 4 4 3 3 4 4 4 4 4 3 3 3....xP, on trouve combien la position de fragmentation en arrière du 30e segment sétigère, telle que entre les segments 34 et 35, 40 et 41, 44 et 45, 48 et 49, 52 et 53, 56 et 57, 60 et 61, 64 et 65, 67 et 68, 70 et 71, 73 et 74, 76 et 77, est d'accord avec la position où se forme la chaîne des stolons. De plus, d'après Allen (1927, p. 874), la formule de fragmentation chez l'*Autolytus Edwarsi* est H (7 2 2) 2 3 3 3 4 4 4 3 etc. faisant une chaîne de stolons. Si, comme dans l'exemple précédent, la position de la chaîne est réglée par celle de fragmentation de cette formule, la chaîne de cette *Autolytus* doit se produire évidemment entre les segments 16 et 17, 19 et 20, 22 et 23, 26 et

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*Le chiffre mis entre parenthèses indique le nombre des individus observés.

27, 30 et 31, 34 et 35, 37 et 38.   Et en examinant 205 spécimens recueillis
à Plymouth, j'ai constaté en effet que cette position était entre le 22e segment
(4) avant et le 40e (2) arrière : 26e (35), 30e (79), 34e (64), 37e (20) (sauf un
seul cas formé immédiatement après le 33e segment), et une concordance bien
nette pouvait s'apercevoir ainsi entre ces deux observations.

Maintenant, il s'agit de la position où apparaît la chaîne des stolons chez
l'*Autolytus variens* rapportée par Mensch (1900).   D'après lui, elle se trouve
en arrière des segments suivants : 19e (1), 21e (1), 24e (2), 25e (5), 26e (4), 29e
(9), 30e (16), 31e (5), 32e (19), 33e (4), 34e (20), 35e (10), 36e (5), 37e (14), 38e
(13), 39e (9), 40e (6), 41e (4), 45e (2), 48e (3), 52e (2), 58e (1), et comme on le
voit, elle se succède du 29e jusqu'au 41e segment.   Dans ce cas-là, la position
de la chaîne ne suit-elle pas la formule générale donnée plus haut ?

Il faudrait pour cela tenir compte de ce qui suit : 1°) le nombre des
segments qui constituent l'unité de fragmentation n'est pas constant ; il est
souvent variable d'après les observations d'Allen (1926) sur la *Procerastea
Halleziana*, et les 3 segments d'une unité, par exemple, sont remplacés par 2
plus 1 ou par 1 plus 2, et les 4 segments par 1 plus 3 ou 2 plus 2 ou bien
3 plus 1.   2°) une chaîne de stolons peut obtenue expérimentalement par
n'importe quelle position, bien entendu, dans le champs de la stolonisation, c.-
à-d. dans la limite de sa formation possible (Okada 1934).   3°) comme il a
été indiqué par Malaquin, la position de la stolonisation n'est pas bornée à
celle où se détache le premier stolon, et elle se déplace plutôt plus en avant.
La forme la plus compliquée provenant de l'entre-croisement des trois phéno-
mènes ci-dessus énumérés serait le déplacement de la position où est formée
la chaîne des stolons chez cette *Autolytus variens*, mais quoi qu'il en soit, il
est indiscutable que la position de fragmentation fondamentale y participe
d'une façon très nette.   La position où la chaîne des stolons se forme le plus
par intervalle en arrière du 42e segment et aussi dans la région s'étendant du
29e jusqu'au 41e segment, correspond toujours à celle qui est déterminée par
la formule de fragmentation, à savoir, entre les segments 30–31, 34–35, 37–
38, etc., sauf pour la position entre les segments 32 et 33.   Pour résoudre pour-
quoi la formation de la chaîne est fréquente aussi dans le 32e segment, nous
regrettons de ne pouvoir trouver aucune indication convenable.   On doit re-
marquer qu'en observant à part des individus d'*Autolytus Edwarsi* de provenance
différente, la position de formation de la chaîne est plus ou moins variable à
partir de celle que nous venons de détailler ; par exemple, dans 34 spécimens
trouvés dans le Plymouth Sound, cette position se trouvait entre les segments
22–23 (3), 26–27 (18), 30–31 (12) et 34–35 (1), et sa fréquence maximum entre
les segments 26 et 27, tandis que dans 46 spécimens recueillis à Wintershool à
la même époque, elle était entre les segments 22–23 (1), 26–27 (1), 30–31 (12),
34–35 (22), 37–38 (7), 40–41 (2) (sauf un seul cas exceptionnel), et sa fréquence
maximum plus reculée se trouvait entre les segments 34 et 35 ; cela proviendrait
peut-être de ce que ce dernier groupe de spècimens avait une taille plus longue
c.-à-d. des segments plus nombreux que les autres qui vivaient sur les côtes.
Et en mélangeant ces deux cas, on peut trouver la fréquence maximum de la

position en question entre les segments 30 et 31. En rapport avec le caractère d'avancement de la position de stolonisation, que l'on voit souvent dans la stolonisation de cette espèce, la position de la chaîne varie non seulement suivant les endroits de pêche, mais encore suivant les époques de la stolonisation. Enfin, nous ajoutons que la formation de la chaîne se manifeste toujours entre les segments 30 et 31 chez ces trois espèces d'*Autolytus* ayant la position déterminée de la gemmiparité : *Autolytus maculatus* d'après Potts (1911, p. 36), *Autolytus orientalis* d'après Willey (1905) et *Autolytus purpleipunctatus* d'après moi (1933 a).

LES STOLONS ET LEUR CARACTÈRE SEXUEL

La distinction sexuelle des stolons chez les Syllidés se fait uniquement par la coloration des segments génitaux ou par le degré de métamorphose des parapodes. Or, chez les Autolytidés, elle est plus remarquable : le stolon mâle forme un *Polybostrichus* ayant une paire de tentacules bifurqués à l'extrémité antérieure, et le stolon femelle une *Sacconereis* portant des oeufs à la face ventrale. L'un et l'autre présentent une structure plus développée que les stolons des Syllidés. Cependant, il n'est pas juste de distinguer les stolons, comme on le croyait, d'après la présence ou l'absence de tentacules sur la tête et le nombre de ces tentacles. La tête de la *Sacconereis* de *Myrianida*, par exemple, n'a pas de cirres tentaculaires ventraux ; elle est nettement « tête pentacère ». Par contre, chez les stolons que j'ai observés à Séto et qui était du type *Ioda* de la *Typosyllis fascinata*, la structure de la tête était quelquefois plus parfaite que dans le cas de la *Myrianida* et les cirres tentaculaires étaient développés en haut et en bas des deux côtés. D'autre part, le type *Tétraglène* était bien le nom donné à la tête acère de la *Trypanosyllis zebra* ; or, les stolons de la *Trypanosyllis crosslandi* (Potts 1911, p. 17, fig. 4) et de la *Trypanosyllis asterobia* (Okada 1933 a, p. 330, fig. 5) avaient nettement des tentacules latéraux ou des appendices analogues, et de plus on remarquait même, pour la première espèce le développement d'une paire de cirres tentaculaires. Pour cette raison, si on les qualifie uniquement suivant le nombre des appendices capitaux, sans tenir compte de leur caractère général, les stolons de ces *Trypanosyllis* devraient être classés plutôt dans le type *Chaetosyllis*. Il est aussi nécessaire de tenir compte pour la classification des stolons de leur souche asexuée, et il est juste de désigner les stolons du genre *Trypanosyllis* et ceux de la *Syllis ramosa* ayant une même constitution que le précédent sous le nom de *Tétraglène*, ceux de la *Typosyllis prolifera* et d'autres espèces analogues sous le nom de *Chaetosyllis* et enfin les stolons des Syllidés mieux développés que les précédents, par exemple, ceux de la *Typosyllis fascinata* sous le nom d'*Ioda*. Et quels que soient la structure et l'état de développement de la tête de chaque stolon il faut donner au stolon mâle chez les Autolytidés le nom général de *Polybostrichus* et au stolon femelle le nom de *Sacconereis* ; cette désignation étant habituellement employée, je crains qu'il ne soit superflu d'y revenir. En somme, la présence ou l'absence des tentacules ou l'importance

de leur nombre, ne concernent que la différence du degré de développement
d'une tête. Même chez la *Sacconereis* ou chez le *Polybostrichus* ayant la tête
très compliquée, le stolon se trouve au stade sans cirre au moment de son
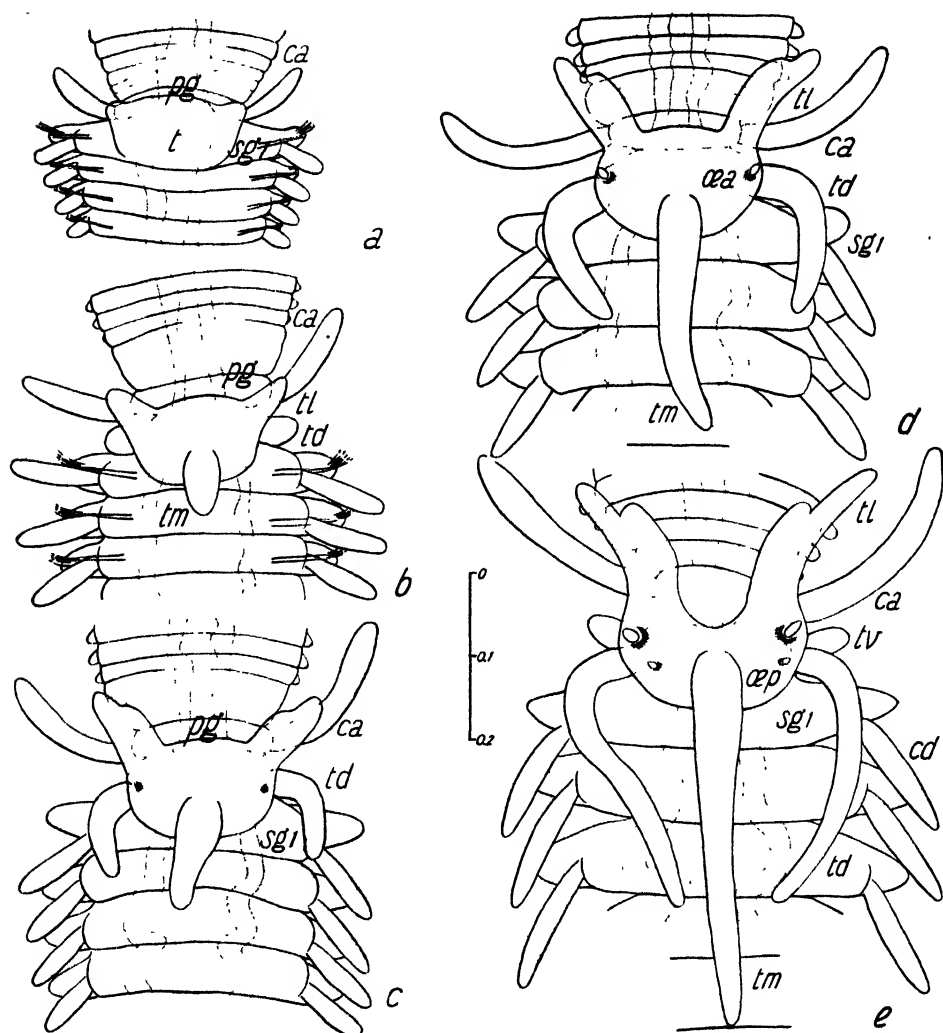
Fig. 26.   Séries en développement de la tête dans la chaîne des stolons mâles chez l'*Autolytus
     Edwarsi*; *a*, un stade avant l'apparition de l'appendice et de l'oeil.   *b*, un tentacule médian
     et une paire des latéraux font leur apparition.   *c*, une paire de cirres tentaculaires dorsaux
     apparaissent et les yeux antérieurs commencent à se former.   *d*, les appendices et les yeux
     se trouvent en même état que le précédent, leur développement étant plus avancé.   *e*, une
     paire de cirres tentaculaires ventraux et une paire d'yeux postérieurs sont formées.   *ca*, *pg*,
     cirre et segment anal du stolon placé immédiatement avant un autre.

apparition (fig. 26 a) et passe peu à peu au stade à trois cirres c.-à-d. ayant
un cirre médian et une paire de saillies à droite et à gauche de son extrémité

antérieure (fig. 26 b) ; ensuite. il arrive au stade penta-cirre par suite de l'appari-
tion d'une paire de cirres tentaculaires dorsaux (fig. 26 c–d), enfin au stade
hepta-cirre par production de cirres tentaculaires ventraux (fig. 26 e).   En rela-
tion avec le développement de ces appendices, se produisent deux paires de
gros yeux ; l'époque de l'apparition de ceux-ci varie naturellement suivant les
espèces.   Le fait qu'une paire d'yeux antérieure se déplace vers le côté ventral
est une indication caractérisant le stolon au stade avancé (fig. 27).   Chez les
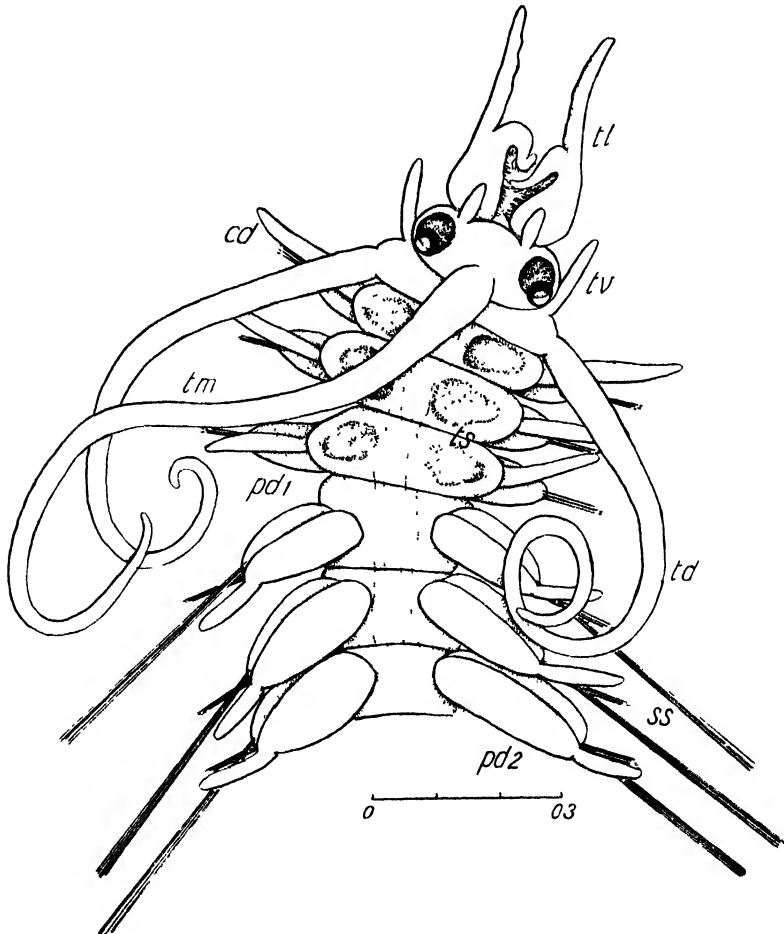
Fig. 27. Partie antérieure d'un stolon mâle d'*Autolytus Edwarsi* en développement
parfait, trouvé dans le plancton. *pd1*, parapode non-modifié de la région antéri-
eure; *pd2*, parapode modifié de la région médiane.

stolons schizogames aucun moyen n'existe que d'observer ces phénomènes
suivant le temps qu'il faut à un même individu, tandis qu'il est possible, chez
les stolons gemmipares, de les constater à la fois dans une chaîne de stolons
en les suivant un à un d'avant en arrière.

D'autres caractères des stolons des Autolytidés qui diffèrent de ceux des Syllidés sont : 1°) que chez les stolons mâles, la position des glandes génitales est à peu près fixée et même limitée à quelques segments antérieurs ; et chez les stolons gemmipares courts, elle est toujours limitée aux trois premiers segménts (voir la fig. 27) et chez les stolons schizogames longs, à six segments. Tant chez les mâles que chez les femelles, la métamorphose des parapodes et l'apparition des soies natatoires font défaut aux segments antérieurs en question. Même dans le cas où la région antérieure non-modifiée s'étend jusqu'aux 14 segments, chez la *Proceraea longeferiens* par exemple (Okada 1929 a, p. 581, fig. 31), la production des spermatozoïdes est limitée seulement aux 5 ou 6 derniers. 2°) que dans les stolons de ces Autolytidés, les femelles portent des oeufs à la face ventrale du corps jusqu'à l'éclosion. En rapport avec ce fait, un grand développement de la néphridie est aussi remarqué chez les femelles et des glandes excrétoires particulières existent près de son orifice, ce qui diffère du cas de Syllidés. L'excrétion causerait la formation d'un sac membraneux transparent contenant la masse des oeufs. Chez les stolons gemmipares, ce sac est généralement unique et présente une forme sphérique ou ovoïde, tandis que chez les stolons schizogames longs, il est plutôt divisé en deux parties, antérieure et postérieure, inégales et parfois en plus. Chez la *Procerastea Halleziana*, les stolons portent en effet huit sacs en poire à droite et à gauche
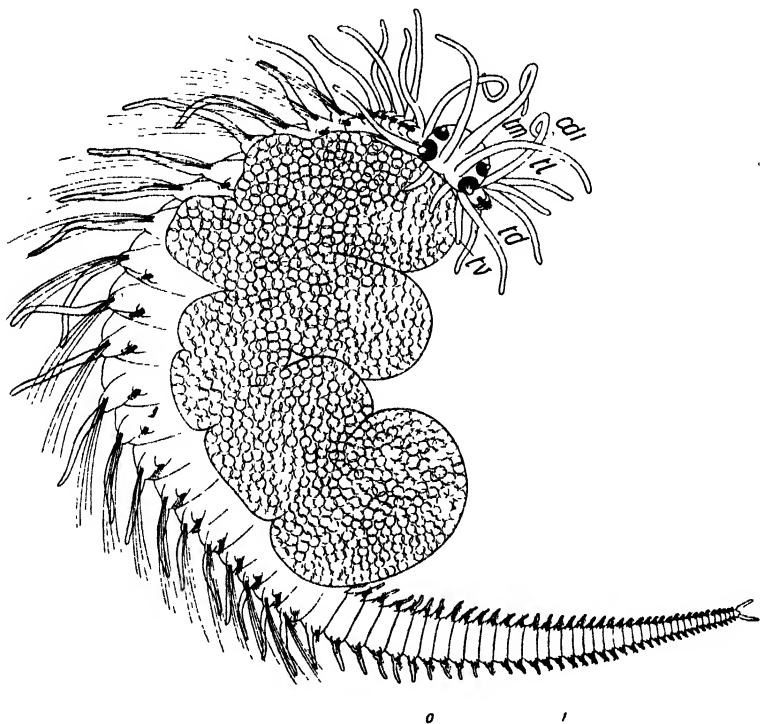
Fig. 28.   Stolon femelle de *Proceraea aurantiaca* portant le sac aux oeufs.

quatre par quatre (fig. 21 b). D'autre part, comme moyen de porter la masse des oeufs, la *Sacconereis* de certaines espèces de *Proceraea*, telles que *P. picta* et *P. aurantiaca*, possède des appendices particuliers au bas de la tête et en avant du cirre tentaculaire ventral de chaque côté, et grâce à eux, elle tient solidement ses oeufs par le devant (fig. 28). Chez l'*Autolytus purpureimaculatus*, les oeufs s'accolent presque toujours à la face ventrale sans former de sac, et les stolons eux-mêmes rampent sur le sous-sol. De plus, les *Sacconereis*, seules de cette espèce, malgré leur origine gemmipare, possèdent 6 segments antérieurs non-modifiés, 20 segments médians modifiés et 10 segments postérieurs non-modifiés (cf. Okada 1933 a, fig. 11, p. 337).

Comme ce mémoire le précise dès le début, le caractère des stolons Syllidiens que nous venons d'expliquer ci-dessus en le comparant à celui des stolons asexués des autres Annélides, se trouve dans la modification sexuelle de la structure que prennent les nouveaux individus pour accomplir leur fonction spéciale de reproduction. On peut comprendre facilement que ce phénomène a des relation importantes avec la maturité des éléments sexuels. Pour en faire la preuve, on peut produire sans difficulté la formation d'un stolon par décapitation d'un individu n'ayant pas encore d'indication de stolonisation. Cependant, tant que les éléments sexuels ne mûrissent pas au cours de l'accroissement de la tête du stolon, celui-ci ne présente jamais le caractère sexuel spécifique et se trouve asexué comme une régénération à l'extrémité antérieure du corps primitif (cf. Okada 1934, fig. 2, p. 390). D'autre part, chez une des espèces qui effectuent la reproduction directe, par exemple, chez l'*Eusyllis lamelligera*, les yeux et les tentacules au stade asexué présentent une métamorphose sexuelle directe, avec la maturité des éléments sexuels. Par conséquent, ce caractère sexuel ayant des rapports directs avec la maturité des éléments sexuels pourrait se comparer aux relations entre l'hormone et les caractères sexuels secondaires des vertébrés qui varient suivant les saisons ; on peut en attribuer la cause aux produits de sécrétion interne des glandes génitales ou, d'une manière plus directe à l'action humorale des éléments sexuels euxmêmes. Dans cette hypothèse, on se heurte à un fait très embarassant, c'est que cette action humorale n'amène pas la métamorphose sexuelle de la tête asexuée de la souche dans le cas de stolonisation des Syllidiens schizogames. Mais, puisque l'influence de cette action est déjà reconnue chez certaines espèces épigames, il est naturel qu'on ne puisse la nier non plus dans ce casci. On doit donc supposer que quelque chose de puissant existe en effet dans la partie antérieure du corps pour la rendre nulle, ou alors que cette action dépende du degré de sensibilité des segments de la souche. Si l'on admet cette dernière hypothèse, il faut considérer le caractère morphologique de la tête asexuée dans la souche comme absolument déterminé et cette détermination comme terminée au cours de son évolution ontogénique ; or, chez les espèces épigamiques, ce caractère est considéré comme indéterminé même après la formation de la tête. Pour en avoir la preuve exacte, j'ai fait une plaie cunéiforme sur un seul côté de plusieurs segments en avant et en arrière du 14e sétigère de la *Proceraea picta* et vu le corps du ver formant là un crochet par

cicatrisation de la plaie; après avoir attendu le développement des glandes génitales de ce spécimen, je lui ai extirpé, en lui conservant quelques segments antérieurs, la partie courbée en avant du segment critique et remarqué la forme de la tête qui venait de se reproduire là. Si j'avais provoqué une cicatrisation látérale entre les antérieurs et les postérieurs du 14e segment avant d'avoir opéré cette amputation, c'était naturellement pour faire exercer des actions plus
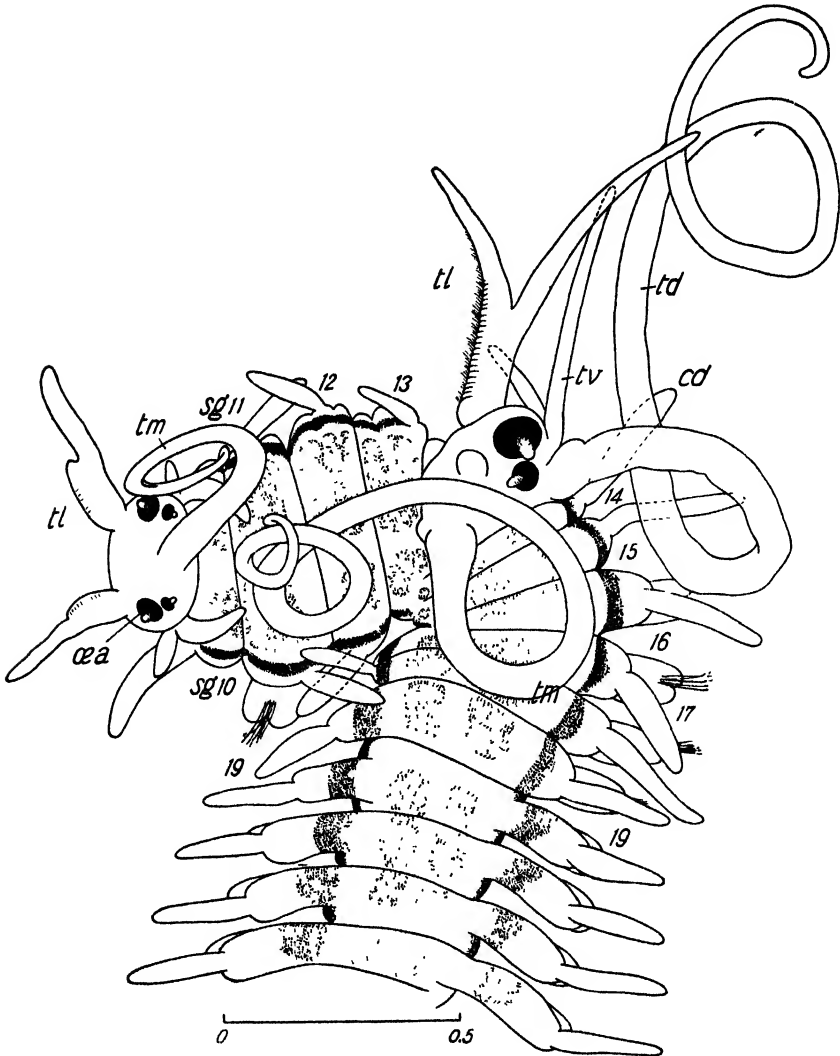
Fig. 29. Résultat de l'expérience démontrant l'effet humoral sur le caractère de la tête régénérée de la maturité sexuelle chez la *Proceraea picta*: — Régénération d'une tête de stolon sur le segment de la souche asexuée, après soudure des deux parties, antérieure et postérieure, du 14e segment et après amputation de la partie antérieure des segments au moment de la maturité des éléments sexuels.

accentuées sur le régénérateur par les éléments sexuels qui mûrissaient en arrière du segment en question. D'autre part, si j'ai choisi un ver mâle pour cette expérience, c'est que le caractère sexuel du *Polybostrichus*, stolon mâle, était très facile à reconnaître et que la pratique se faisait presque sans erreur.

D'après les résultats de cette expérience, quoique l'expression du caractère de sexe fût encore bien imparfaite sur la nouvelle tête régénérée, celle-ci était très différente de la tête asexuée ordinaire, possédant à la base des tentacules latéraux un épaississement du *Polybostrichus* et aussi des taches oculaires très grosses (fig. 29). D'ailleurs, en examinant la régénération antérieure des spécimens amputés à différents stades du développement des glandes génitales dans une région suivant le 14e segment, j'ai vu apparaître des variations de tous degrés s'étendant du *Polybostrichus* presque parfait jusqu'à la tête asexuée ordinaire. La figure 30 représente un cas où le développement du caractère sexuel est nettement inférieur, pour ce qui est de l'indication de l'influence des éléments sexuels, à celui que j'ai vu, dans l'expérience précédente, à la tête régénératrice précédant le 14e segment. En m'appuyant sur ces résultats obtenus, je peux dire avec conviction que le caractère spécial de la tête sexuée chez les stolons Syllidiens provient des influences des produits sécréteurs qui sont en relations directes ou indirectes avec la maturité des éléments sexuels.

La métamorphose des segments, surtout celle des parapodes en nageoires se manifeste en même temps

Fig. 30. Résultat de l'expérience-contrôle de la précédente : — Régénération de la tête presque asexuée dans une coupe en arrière du 14e segment avant la maturité sexuelle du ver.

que la tête du stolon, ayant une relation de position avec elle. Cependant, cette métamorphose ne peut être mise dans la même catégorie que les caractères sexuels de la tête précités, car une telle métamorphose paraît ne pas avoir, en plusieurs points, de relations directes avec la présence des éléments sexuels. Par exemple, comme on le sait, lorsqu'une tête de stolon est formée, par suite de l'avancement de la position de stolonisation, à un niveau plus avancé de

quelques segments que le niveau précédent, ces segments qui n'ont manifesté aucun changement pour la première fois subissent maintenant aussi, en rapport avec la formation de cette tête, une transformation particulière à l'individu sexué, c.-à-d. la transformation des parapodes en nageoires, comme des segments régénérés en arrière. D'autre part, chez certaines espèces d'Autolytidés, il arrive parfois que les éléments sexuels viennent à maturité même à une autre qu'à l'époque de la stolonisation et remplissent les segments (Okada 1933 b, p. 649). En pareil cas, s'il n'y a pas de formation de la tête du stolon, la transformation des parapodes en nageoires ne se produit pas non plus. Par conséquent, il paraît que la production des éléments sexuels et la formation de la tête chez elles ou le phénomène de séparation y correspondant chez les *Haplosyllis spongicola* et *Typosyllis cirropunctata* ont une signification importante pour la transformation des parapodes. Quoi qu'il en soit, je crois que c'est une métamorphose sexuelle qui n'a aucun rapport direct avec le developpement des glandes génitales ou avec la présence des éléments sexuels et que c'est un tout autre caractère du stolon que celui qui apparaît à la tête.

Je veux donner encore quelques remarques sur la structure des stolons : c'est que, malgré que leur tête et les segments qui la suivent présentent le même degré de complication que la tête et les segments suivants de la souche, il n'existe au canal alimentaire ni pharynx, ni proventricule, ni ventricule, ni aucun appendice glandulaire de tous ces organes ; que chez les Polychètes en général le pharynx n'opère jamais sa récupération par la partie intestinale postérieure, comme chez les Oligochètes. D'après mes observations sur les Syllidiens au moins, tous les organes d'origine ectodermique, depuis la bouche jusqu'à l'extrémité postérieure du ventricule*, sont formés d'ectoderme par une invagination stomodéale, même au moment de la régénération (Okada 1929 a, p. 563). Et si l'on supprime expérimentalement une partie ou la totalité d'un des organes pharyngiens sans amputer les segments antérieurs, la régénération n'aura lieu jamais en avant ou en arrière des autres régions épargnées. Par conséquent, la récupération de la partie perdue ne se manifestera jamais sans une nouvelle invagination stomodéale ; il n'en est pas de même, cependant, quant à la région intestinale, et tout en lui supprimant une partie, on peut observer facilement que se produit un allongement supplémentaire de la partie restante et que se réalise quelques jours après une soudure parfaite. Parfois il arrive que lorsqu'on supprime tous les organes pharyngiens, ceux-ci ne se régénèrent plus, mais que l'intestin arrière s'allongeant, son extrémité antérieure atteigne la bouche (fig. 4, pl. XXIII.). Dans ce cas, sa structure interne ne diffère point de celle du stolon.

En observant l'état de développement de la tête du stolon, on apercevra facilement que celle-ci fait· son apparition à la face dorsale d'un segment de la partie médiane du corps et que le canal alimentaire ne se rompt pas généralement jusqu'au dernier moment de la séparation du stolon (voir la fig.

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*Dans une étude précédente (1929, p. 578), j'ai cherché à l'élément intestinal l'origine des coecums ventriculaires: d'après mes observations détaillées sur sa structure cellulaire et mes expériences ultérieures, c'est toujours d'origine ectodermique par invagination stomodéale.

25). Dans un tel état, l'invagination stomodéale ne prendra jamais naissance et la faculté de régénérer le pharynx fera défaut naturellement au stolon.

CONCLUSIONS

J'ai donné ci-dessus un coup d'oeil sur la stolonisation des Syllidiens ; les explications en auraient été trop brèves dans chacun des cas, mais je pense qu'elles étaient assez suffisantes pour traiter ces phénomènes chez cette tribu des Annélides, faisant l'objet du présent mémoire.

I. Sans parler de la causalité existant entre ce mode de reproduction et la reproduction directe où le ver lui-même accomplit le rôle de reproduction par sa propre transformation directe, la première indication de la stolonisation elle-même est évidemment la séparation de la partie postérieure du corps du ver. Pour cette raison, la formation d'une tête ou d'une queue ou bien de l'une et l'autre est un phénomène secondaire qui se manifeste après. Chez les Auto-lytidés, le phénomène d'archytomie n'existe pas, mais il est douteux que leur stolonisation soit plus avancée que tous les cas des Syllidés. Les stolons des premières ont toujours la structure de la tête plus parfaite que les autres et encore la distinction nette des sexes ; or, chez certaines espèces de *Trypanosyllis* telles que *T. gemmipara* mentionnée par Johnson ou *T. asterobia* trouvée par moi-même, le mode de stolonisation ne paraît pas inférieur à ceux des Auto-lytidés les plus compliqués. Dans ces deux cas, la stolonisation serait partie de la division simple du corps, mais on ne pense pas que le phénomène en suive le même processus pour les unes et pour les autres. D'après de nombreuses observations faites, il semble qu'ils suivent indépendamment leur évolution particulière. Chez les Autolytidés la régénération postérieure apparaissant de bonne heure, avant la séparation du stolon, est toujours localisée à la face postéro-médiane du corps-souche, tandis que chez les Syllidés elle se produit à la face ventro-médiane du dernier segment de la souche. Il se produit chez les derniers, en rapport avec la formule de cette régénération postérieure, les stolons en faisceau qu'on voit chez les *Trypanosyllis*, tandis qu'on voit apparaitre chez les premiers une longue chaîne de stolons successifs qu'on observe chez les *Myrianida* et les *Autolytus*.

Chez les Autolytidés en voie de stolonisation, la tête du stolon a un bon développement et présente une haute différenciation mais la régénération de la queue est complètement réprimée dans trois genres : *Proceraea, Procerastea, Vichowia*, et les segments postérieurs perdus ne se régénèrent qu'après la séparation du stolon. Par conséquent, chez ces trois genres, plus d'un stolon n'apparaissent jamais à la fois, mais il n'est pas certain que la stolonisation se développe chez eux directement à partir de l'archytomie primitive. Ne devrait-on pas la considérer plutôt comme transformée de la gemmiparité vers la paratomie actuelle en voie d'évolution, à cause de la régénération postérieure réprimée ? Dans ce sens, on pourrait distinguer ce type de stolonisation et le cas de séparation d'un seul individu qui apparaît souvent au début de la forma-tion de la chaîne chez l'*Autolytus Edwarsi* et chez d'autres espèces voisines.

Chez les *Myrianida*, à aucune époque de la stolonisation un seul individu ne se détachera de la souche, sauf le dernier peut-être. La première indication de la stolonisation produit immédiatement la formation de la chaîne.

Chez les Syllidés, le développement de la tête du stolon n'est pas très intense en général, et même dans le cas le plus favorable il ne dépasse jamais le degré de *Chaetosyllis*. La tête du type *Ioda* ne peut se produire dans le stolon détaché, tant que celui-ci s'attache à la souche. Or, la regénération postérieure est alors meilleure que dans le cas d'Autolytidés ; surtout chez les *Trypanosyllis*, la régénération caudale est souvent bien avancée, quoique la tête du stolon n'atteigne qu'au degré de *Tétraglène* où se produisent seulement deux paires d'yeux. Naturellement, cette régénération caudale est toujours provoquée par l'apparition de la tête du stolon en arrière. Lorsque beaucoup de têtes de stolon prennent naissance en série chez les *Typosyllis*, plusieurs queues se forment aussi en série. Comme nous l'avons dit plus haut, la gemmation de la *Trypanosyllis asterobia* est un phénomène développé de cette formation polycéphalique des *Typosyllis*. En tenant compte des faits précités, nous pouvons chercher l'origine du bourgeonnement le plus intéressant chez les Syllidiens, comme l'indique le schéma suivant, dans trois types différents et diverses étapes de leur évolution respective.

Archytomie

Stolon non-mûr au moment de la séparation ; après séparation, il peut se développer en un type *Ioda*. Ex.: *Typosyllis armillaris*.	Stolon déjà mûr au moment de la séparation ; stolon acéphalique Ex.: *Haplosyllis spongicola*.

Paratomie

Syllidés	Autolytidés
Régénération antérieure inférieure à la régénération postérieure ; celle-ci se manifeste à la face ventro-médiane du dernier segment de la souche ; queue rudimentaire séparée en demi-rudiments. Ex.: *Typosyllis prolifera*.	Régénération antérieure supérieure à la régénération postérieure ; celle-ci se manifeste à la face postéro-médiane du dernier segment de la souche.

| Production polycéphalique et régénération caudale dans les segments successifs. Ex.: Pluricéphalisation chez les *Typosyllis*. ↓ Gemmation de la *Trypanosyllis asterobia*. | Demi-rudiments de queue se soudant avant la séparation du stolon. Ex.: *Trypanosyllis zebra*. ↓ Gemmation de la *Trypanosyllis gemmipara* et des formes alliées. | Régénération caudale réprimée. Ex.: *Proceraea, Procerastea, Virchowia*. | Gemmation des *Autolytus*. ↓ Phase schizogamique abrégée. Gemmation des *Myaianida*. |

En comprenant ici la stolonisation de la *Syllis ramosa* comme une forme de gemmiparité, on trouve que ce n'est que la paratomie simple se produisant

indépendamment mais simultanément à chacune des branches du corps bien divisées.

II. Différemment de leur souche, les nouveaux individus produits par la stolonisation ont toujours le caractère sexuel particulier ; surtout chez les Autolytidés, la tête est bien différente dans les deux sexes. Et l'indication de tel caractère sexuel a été confirmée comme étant l'effet humoral provoqué par la présence des éléments sexuels dans les segments génitaux des nouveaux individus. On se demanderait alors pourquoi ce même effet n'a pas lieu en même temps dans la tête de la souche. En somme, on peut se rendre compte, par l'ensemble des faits ci-dessus observés, que la métamorphose des tentacules et des yeux n'est plus possible après le perfectionnement de leurs caractères, ne l'étant qu'au cours de leur développement. Par conséquent, si la régénération par amputation tombe juste au moment où les éléments sexuels sont à maturité, les segments antérieurs qui ne participaient pas à la formation du stolon prennent alors le même caractère sexuel que le stolon pour la plupart des cas. Parmi les changements sexuels du stolon, la transformation des parapodes en nageoires et l'apparition des soies natatoires qui se manifestent en rapport avec le phénomène de stolonisation diffèrent de celles que l'on voit sur la tête et ne sont pas sous la dépendance de l'effet direct des éléments sexuels.

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Liste alphabétique des abréviations dans les figures

ac acicule, *an* anus, *br* bourgeon, *ca* cirre caudal, *cd* cirre dorsal, *ct* cuticule, *ds* dissépiment, *ec* ectoderme, *ge* organe génital, *in* intestin, *ms* muscle ou musculature, *n* nerf ou chaîne nerveuse ventrale, *np* néphridie, *oc* ou *oe* oeil, *ov* ovaire, *pc* proctodeum, *pd* parapode, *pg* pygidium ou segment anal, *pr* péritoine, *q* queue, *1/2 q* demi-beurgeon de queue, *sg* segment, *sg n* nouveau segment, *sg v* vieux (ou ancien) segment, *sp* sermatozoïde, *ss* soie natatoire, *t* tête, *td* cirre tentaculaire dorsal, *tl* tentacule latéral, *tm* tentacule médian, *ts* testicule, *tv* cirre tentaculaire ventral, *v* vaisseau sanguin, *vd* vaisseau dorsal, *vv* vaisseau ventral, *z* zooïde ou stolon, *zf* zoonïte formateur des individus de la chaîne, *zff* zoonïte formateur des segments d'un stolon, *zs* niveau de séparation (ou scissiparité).

Explication des Figures dans la planche

1. Région postérieure de *Trypanosyllis asterobia* en période de stolonisation; les stolons plus jeunes et plus vieux se séparent en deux groupes, le début de chaque groupe étant marqué avec une flèche.
2. Deux stolons mâles de *Syllis ramosa*.
3. Section médiane longitudinale de la partie antérieure d'*Autolytus Edwarsi*.
4. La même du spécimen dont le pharynx est expérimentalement remplacé par l'intestin.
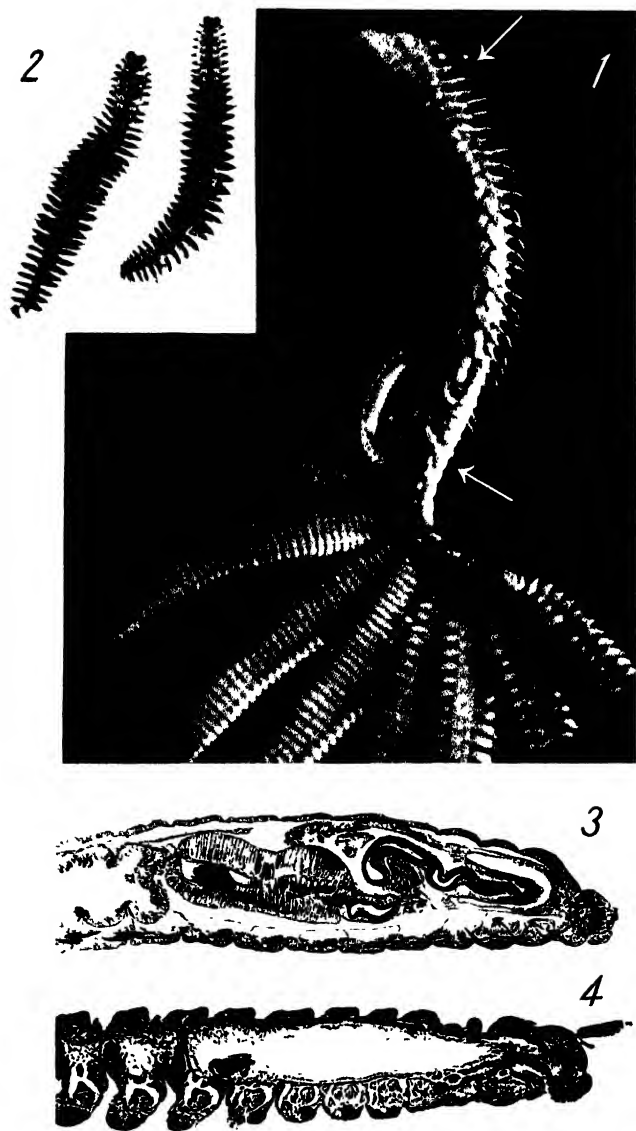
20. Studies on the Helminth Fauna of Japan
Part 20. Larval Trematodes from Marine Fishes

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(With Plates XXIV–XXV)　.

The trematode larvae collected from marine fishes since my previous report (Part 2 of the series) are described in the present part. Although feeding experiments have not been carried out, the morphological and ecological evidences are sufficient in some cases to identify the worms involved. It is very interesting to note that the larval trematodes found so far in Japanese marine fishes, with some exceptions, come to maturity in piscivorous marine fishes.

1. *Prosorhynchus (Skrjabiniella) aculeatus* Odhner, 1905

Pl. XXIV, fig. 1.

On July 28, 1935, some ten oval cysts were found in the fins of *Pseudorhombus cinnamomeus* (Temm. et Schleg.) from the Inland Sea. As fixed in acetic sublimate under a cover glass they measure 0.48–0.7 mm long by 0.32–0.45 mm broad and consist of an inner hyaline and an outer connective tissue membrane, the thickness of the latter increasing with the duration of infection.

As liberated from the cyst and fixed in acetic sublimate under a cover glass the larva is elongate oval and 0.5–0.73 mm long by 0.3–0.38 mm broad. The apical organ, $60-72 \times 105-123 \mu$, is thickened and elevated at the margin and drawn out posteriorly. The unicellular adhesion gland cells are massed in the median field between this organ and the vitellaria. The pharynx, up to 0.1 mm in diameter, lies at about the middle of the posterior half of the body. The peri-esophageal gland cells are well developed. The intestine 0.1–0.15 mm wide extends a little further forward than the middle of the body.

The oval testes, $75-100 \mu$ in length, lie one on each side of the beginning of the intestine, the left one a little further in front. The cirrus pouch extending to the left testis contains a coiled tubular vesicula seminalis and a wider pars prostatica surrounded by prostatic cells. The funnel-shaped genital sinus, into which the crooked genital lobe projects prominently, opens on the ventral side of the posterior extremity.

The oval to subglobular ovary, $60-87 \times 50-78 \mu$, lies anterodorsal to the right testis. The vitellarian anlagen are arranged in two lateral groups at about the junction of the anterior with the middle third of the body. The

voluminous excretory vesicle extends on the dorsal side from the posterior end
of the body to near the middle of the right testis.

As compared with the larva which I reported from *Rhinogobius* sp. this
worm is much smaller and has a relatively large pharynx, but I venture to
refer it for the present to the same species.

Skrjabiniella Issaitschikow, 1928, is regarded as subgenus of *Prosorhynchus*
Odhner, 1905.

2. *Prosorhynchus (Skrjabiniella) uniporus* Ozaki, 1924

Pl. XXIV, fig. 2.

In my former paper I reported this larva from *Callionymus lunatus* Temm.
et Schleg. The present note is based on one of the specimens from the fins
of *Acanthogobius flavimanus* from Hamanako.

As fixed in acetic sublimate under a cover slip the elliptical body covered
with minute spines measures 0.49 mm in length and 0.19 mm in maximum
breadth at the middle. The apical adhesive disk is 48 μ thick in the center
and 75 μ in diameter. The pharynx, $51 \times 54\,\mu$, lies at the junction of the
middle with the posterior third of the body. The esophagus is surrounded by
a dense mass of glandular cells. The voluminous intestine 0.1 mm wide lies
in the middle third of the body. The testes lie one on each side of the pha-
rynx, the right one being $66 \times 36\,\mu$ and slightly behind the left, which measures
60 μ by 27 μ. The club-shaped cirrus pouch, 0.12 mm long by 45 μ broad,
extends to near the left testis; it contains a tubular vesicula seminalis, a com-
pact mass of prostatic cells and a vesicular pars prostatica. The genital sinus
opens at the posterior extremity in direct contact with the excretory pore. The
ovary, $39 \times 24\,\mu$, is situated in front of the right testis at the level of the
esophagus. The vitellarian anlagen are not distinctly recognizable because of
inadequate staining. The wide excretory vesicle extends on the right of the
cirrus pouch to near the right testis.

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    p. 275-278.

3. *Gotonius* larva

Pl. XXIV, fig. 3.

A single encysted metacercaria was obtained from the tail fin of *Acan-
thogobius flavimanus* (Temm. et Schleg.) at Benten-Zima, October 24, 1936.
As fixed in acetic sublimate under a cover slip the nearly cylindrical body
measures 2.1 mm long by 0.5 mm broad. The cuticle is beset throughout with

minute scale-like spines. The nearly funnel-shaped rostellum is 0.188 mm long and has a thick muscular border at its anterior end, which is 0.15 mm in diameter. It contains at the base a mass of gland cells, whose ducts open to the exterior on the apical surface. The pharynx, 90 μ in diameter, lies just behind the middle of the body. The esophagus is surrounded by numerous small gland-like cells as in the known Bucephalid metacercariae. The intestine is voluminous and extends to the posterior end of the anterior third of the body.

The oval testes lie obliquely tandem behind the middle of the body, the anterior on the right of the esophagus and the posterior behind the pharynx. The vas deferens of the anterior testis passes over the pharynx toward the left and round the left end of the posterior testis, whence the two ducts run straight backward.

The muscular cirrus pouch contains a U-shaped vesicula seminalis and a well developed pars prostatica surrounded by a dense mass of prostatic cells. There is a genital papilla projecting into the genital sinus, which opens on the ventral side 0.15 mm from the posterior extremity.

The ovary, smaller than the testes, lies immediately in front of the anterior testis. The germiduct runs backward on the dorsal side of the anterior testis and joins immediately behind it the Laurer's canal, which is markedly swollen at its proximal portion and after a sinuous course opens dorsally to the posterior testis The ootype enclosed in a compact shell gland lies directly behind the anterior testis and a little to the right. The winding uterus passes between the pharynx and the posterior testis and ascends on the left of the intestine as far as the anterior end of the vitellaria, where it turns backward. Behind the posterior testis it forms conspicuous convolutions and finally opens from the right into the genital sinus.

The vitelline follicles are poorly developed on either side in front of the intestine and their number is unable to make out with certainty. The left vitelline duct unites with its fellow on the right side of the pharynx.

The long tubular excretory vesicle opening at the posterior tip of the body reaches to the anterior testis.

In view of morphological resemblance and the fact that the host fish is devored by *Platycephalus indicus* living in the same locality, it seems likely that this larva belongs to *Gotonius platycephali* Yamaguti, 1934.

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4. *Dolichoenterum longissimum* Ozaki, 1924

Pl. XXIV, figs. 4 5; Pl. XXV, fig. 8.

Numerous larvae of this species were obtained at Kôti, November 15 and 16, 1936, from *Callionymus altivelis* Temm. et Schleg., *Chrionema chryseres*

Gilbert and *Hoplichthys regani* Jordan et Richardson. They were encysted in the fins and muscles, especially near the bases of the pectoral and caudal fins (Pl. XXV, fig. 8).

As fixed in acetic sublimate under slight cover glass pressure, the nearly cylindrical body covered with minute spines measures 2.3–10.2 mm in length and 0.5–0.9 mm in maximum breadth. Of the subcuticular musculature the outer longitudinal and inner diagonal fibers are well developed. The anterior sucker with a wide anteroventral opening is 0.3–0.9 mm in diameter and bears on its anterodorsal margin eight conical muscular projections arranged in a semicircle. Behind the sucker there are numerous pyriform gland cells, whose ducts open to the outside along the ventral margin of the sucker as well as along the sides of the projections mentioned above.

The ventral mouth leads directly into the pharynx, which is 0.13–0.25 mm in diameter and lies usually in front of the middle of the body, but occasionally behind it. The short esophagus is directed anterodorsad and surrounded by numerous gland cells containing fine granules. The simple tubular intestine turns backward a short distance in front of the pharynx and terminates beside the cirrus pouch. It may be distended with brownish granular ingesta.

The rounded testes, 0.08–0.3 mm in length, lie obliquely tandem on the dorsal side of the intestine in the posterior fourth of the body; the anterior testis is on the right and only slightly smaller than the posterior. The right vas deferens arising from the dorsal surface of the anterior testis runs down obliquely toward the left on the dorsal side of the intestine and uterus and then backward between the intestine and the posterior testis, where it lies close parallel to its fellow, and unites with the latter before opening into the vesicula seminalis. The fusiform cirrus pouch, 0.15–0.3 mm long by 0.06–0.18 mm broad, has an exceedingly thick wall composed of lamellar muscles and is surrounded by a layer of large cells, whose vesicular nucleus contains a large compact basophil nucleolus and whose protoplasm is filled with relatively coarse mitochondria. The vesicula seminalis is small and lies at the anterior end of the cirrus pouch. The pars prostatica and prostatic cells are well developed. The genital sinus opens by a short duct lined with very thick cuticle into the ventroterminal depression* at the posterior extremity. The ovoid ovary up to 0.1 mm by 0.13 mm lies on the right side behind the anterior testis. After giving off the Laurer's canal the germiduct receives the vitelline duct behind the ovary and passes into the ootype enclosed in the compact mass of shell gland cells. The Laurer's canal opens on the dextrodorsal margin of the body at about the level of the shell gland. The uterus runs forward between the two testes and turns backward a short distance in front of the anterior testis, and passes round the right margin of the posterior testis; it lies dorsal to the intestine and cirrus pouch throughout its length and finally opens into the genital sinus at the sinistrodorsal side of the cirrus pouch. The small vitelline follicles, about 15 on each side, are situated around the vitelline

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* This depression corresponds to the "urogenital pore" of Ozaki.

ducts beginning some distance in front of the anterior testis and running back-
ward in the dorsolateral fields.   The left vitelline duct proceeds to the right
in front of the posterior testis on the dorsal side of the right vas deferens,
uterus and intestine, and unites at a point posterosinistral to the ovary with
its fellow coming down along the ventrolateral margin of the anterior testis
and the dorsomedial margin of the ovary.

The tubular excretory vesicle, somewhat enlarged anteriorly, extends on
the dorsal side of the intestine as far as the anterior end of the cirrus pouch
or slightly further forward ; it opens into the ventroterminal depression mention-
ed above at the dorsal or dorsolateral side of the genital pore.   The main
collecting vessel arising on each side near the anterior end of the vesicle runs
forward in a sinuous course just outside the intestine and bifurcates at about
the level of the pharynx into an ascending and a descending tubule.   The
cephalic nerve commissure lies dorsal to the anterior sucker near its posterior
end and each posterior nerve trunk passes in the submedian line through the
ventral subcuticular cell layer.

On November 18, 1936, a younger larva, apparently of this species, was
found in the flesh of *Arnoglossus violaceus* Franz at Kôti.   The oval cyst,
1.3 mm long by 0.75 mm broad in life, had a thick double-layered wall con-
sisting of an inner delicate and an outer thick connective tissue membrane,
and contained a crooked larva measuring 1.3 mm long by 0.3 mm broad.   As
fixed in acetic sublimate under a cover glass the larva is 1.4 mm long by 0.3 mm
broad.   The relatively thick cuticle is beset throughout with minute spines.
The anterior sucker, 0.27 mm in diameter, bears a row of eight muscular
papilliform projections along its anterodorsal margin.   The pharynx, 90 μ in
diameter, lies just behind the middle of the body.   The intestine extends from
a short distance in front of the pharynx to near the cirrus pouch, which
measures 90 μ by 30 μ.   The anlagen of the reproductive organ are not yet
recognizable.

<div align="center">LITERATURE</div>

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5.   *Stephanochasmus bicoronatus* (Stossich, 1883) Looss, 1901

<div align="center">Pl. XXIV, fig. 6.</div>

On April 23, 1935, several subglobular cysts were collected from the body
cavity of *Acanthogobius hasta* (Temm. et Schleg.) at Okinohata on the coast
of the Sea of Ariake.   As fixed in acetic sublimate under a cover glass they
are 0.57-0.78 mm in length, and the oculate larvae, 1.06-1.9 mm long by 0.38-
0.4 mm broad, gave the following measurements for the principal organs.   Oral
sucker 0.125 × 0.15-0.175 mm ; preyharynx 0.2-0.38 mm long ; pharynx 0.1-
0.12 × 0.075-0.09 mm ; acetabulum in middle third of body, 0.17-0.188 mm in

diameter; testes oval, 63–114 × 84–100 μ, tandem near posterior extremity; ovary oval, 33–42 × 42–54 μ, at anterior end of voluminous excretory vesicle. The circumoral spines, 33 in number and 33–60 μ long, are arranged in two alternate rows except for the symmetrical ventromedian ones, which appear to be in the aboral row and are as long as the aboral nearest them as in *S. cesticillus* (Molin) of Monticelli and *S. bicoronatus* (Stossich) of Looss (fig. 2 b). On the ventral side the oral spines are definitely longer than the aboral, while on the dorsal side those of the two rows are nearly of the same length. In contracted specimen (fig. 6) the cirrus pouch containing poorly differentiated vesicula seminalis, pars prostatica, prostatic cells and ductus ejaculatorius, reaches to the ovary, but in an extended specimen 1.9 mm long it terminates about 0.12 mm in front of the ovary. The Laurer's canal turns back on itself and opens on the middorsal surface at the level of the ovary. The uterus, surrounded distally by numerous Begleitzellen, appears to join the ductus ejaculatorius near the genital pore lying immediately in front of the acetabulum. The shell gland cells form a compact mass in front of the ovary.

Similar cysts, consisting of an outer thick gelatinous and an inner thin transparent membrane, were obtained from the gills of *Sciaena* sp. and *Taenioides lacepedi* (Temm. et Schleg.) from the same locality. As fixed in alcohol the cysts from *Sciaena* sp. are about 0.7 mm in diameter, and the larvae liberated from the cyst 1.25–1.35 mm long by 0.31–0.34 mm broad. Oral sucker 90 × 135 μ; pharynx 115 × 87–90 μ; acetabulum 0.135–0.15 mm in diameter. The circumoral spines are 33 in number and arranged as in the larvae described above. Their lengths are as follows:

Ventral oral spines 39–45 μ

„   aboral „   27–33 μ

Dorsal oral spines 45–48 μ

„   aboral „   36 μ

From the number and arrangement of the circumoral spines it seems likely that the larvae described above belong to *Stephanochasmus bicoronatus* (Stoss.) of Looss. *Distomum imparispine* Linton, 1905, has also 33 or 34 spines around the mouth, but this species should probably be assigned to *Echinostephanus* Yamaguti, 1934.

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6. *Echinostephanus hispidus* Yamaguti, 1934

The encysted larvae of this species were found one each in the flesh of

Pseudorhombus pentophthalmus Günther and *Neopercis sexfasciatus* (Temm. et Schleg.) at Maisaka, October 23, 1936.

The double-layered cyst is subglobular and measures 1.0–1.1 mm broad in the fresh state. As dissected out of the cyst and fixed in acetic sublimate, the worm from *Neopercis sexfasciatus* is 3.9 mm in length and 0.9 mm in maximum breadth at the distended excretory vesicle, whence the body tapers gradually toward the anterior extremity. The cuticular spines beginning at the narrowest part of the neck-region about 45 μ behind the oral sucker are strong enough in the forebody, with their incurved tips projecting prominently over the surface, but become gradually smaller and sparser toward the posterior extremity, where they are almost completely absent. Of the subcuticular musculature the longitudinal fibers are well developed throughout the body, while the circular fibers form very strong bundles in the forebody. A pair of eye-spots are present. The circumoral spine, 42 in number, are arranged as in the adult described in my previous paper. Their measurements taken in life are as follows.

> Dorsomedian oral spines 76×15 μ
>   ,,   aboral ,, 90×15 μ
> Ventromedian oral spines $33 \times$ 9 μ
>   ,,   aboral ,, 42×11 μ
> Lateral   spines 75×13 μ

The terminal oral sucker is nearly disk-shaped and 0.188 mm in diameter. The prepharynx is about 0.4 mm long and the pharynx 195 μ by 93 μ. The esophagus is only 70 μ long. The ceca are simple and open into the excretory vesicle near its pore. The prominent acetabulum, 0.24 mm in diameter, lies in the posterior half of the anterior third of the body.

The elliptical testes lie one behind the other near the posterior extremity, the anterior measuring 0.25×0.135 mm and the posterior 0.31×0.138 mm. The tubular cirrus pouch, 0.78 mm long by 90 μ broad at the posterior end, extends in the median line from 0.25 mm behind the acetabulum to a short distance behind the middle of the body; it contains a sinuous vesicula seminalis, a tubular pars prostatica, prostatic cells and a long ductus ejaculatorius. The latter unites at the anterior end of the cirrus pouch with the metraterm, which functions as ductus hermaphroditicus and opens outside immediately in front of the acetabulum. The ovary is 70 μ long by 75 μ broad and lies in the median line about 0.195 mm in front of the anterior testis, with the shell gland complex immediately in front. The narrow median uterus forms for a distance of about 0.46 mm a slight dilatation provided with a thick coat of gland-like cells and overlapping the cirrus pouch for most of its length. The vitellarian anlagen in the lateral fields of the hind-body begin a short distance behind the acetabulum.

The excretory vesicle is very voluminous and occupies almost the entire posterior end of the body; from its anterior end arises on each side a collecting vessel running forward.

From the above description it appears certain that this larva belongs to

Echinostephanus hispidus Yamaguti, 1934.

I take this opportunity to correct the error in my description of the adult. The ductus ejaculatorius was stated to join the metraterm near the genital pore, but upon re-examination of the original specimens I have convinced myself that the junction occurs some distance behind the acetabulum just as in the larva described above.

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7. *Tormopsolus* larva

Pl. XXIV, fig. 7.

Several elliptical, thin-walled cysts, 0.58–0.9 mm by 0.38–0.48 mm, were found near the gills of *Leiognathus rivulata* (Temm. et Schleg.) at Kôti, November 19, 1936. As fixed in acetic sublimate under cover glass pressure the larva liberated from the cyst is cylindrical and 1.65 mm long by 0.25 mm broad. The cuticle is beset with minute spines in the anterior part of the body except on the ventral median surface. The very conspicuous dark pigment masses representing the eye-spots lie dorsolateral to the pharynx, though observed further in front in the fresh state. The subterminal oral sucker measures 0.16 mm by 0.175 mm, and the pharynx 75 μ by 48 μ. The prepharynx is about 0.12 mm long. The esophagus is very short and bifurcates at the anterodorsal side of the acetabulum. The latter is 0.225 mm in diameter and lies at the posterior end of the anterior third of the body. The simple ceca extending along the sides of the body open into the cloaca at the posterior end of the body. Of the testicular anlagen one is oval, $24 \times 18 \mu$ and lies in the median line near the posterior extremity, but the other is not recognizable. The globular ovary, 22 μ in diameter, lies in the anterior part of the posterior third of the body, with the shell gland complex immediately in front. The poorly differentiated genital ducts of both sexes unite with each other a little behind the acetabulum. The vitellarian anlagen are not yet distinctly developed. The wide tubular excretory vesicle narrows abruptly at the posterior end and forms a laterally enlarged cloaca communicating with the ceca at its lateral corners; it extends on the dorsal side to the ovary and sends out at its anterior end a pair of short lateral horns, each of which is continued anteriorly into a collecting vessel. The latter bifurcates at the level of the prepharynx into an ascending and a descending tubule.

EXPLANATION OF PLATES

Pl. XXIV

Fig. 1. Larval *Prosorhynchus (Skrjabiniella) aculeatus* Odhner, 1905; ventral view, ×100.
Fig. 2. Larval *Prosorhynchus (Skrjabiniella) uniporus* Ozaki, 1924; ventral view, ×100.
Fig. 3. *Gotonius* larva 2.1 mm long; ventral view.
Fig. 4. Larval *Dolichoenterum longissimum* Ozaki, 1924, 8.38 mm long; ventral view.
Fig. 5. Transverse section of same through cirrus pouch.
Fig. 6. Larval *Stephanochasmus bicoronatus* (Stossich, 1883); ventral view, ×50.
Fig. 7. *Tormopsolus* larva; ventral view, ×35.

Pl. XXV

Fig. 8. *Callionymus altivelis* Temm. et Schleg. infected with larval *Dolichoenterum longissimum* Ozaki.

ABBREVIATIONS USED IN FIGURES

a acetabulum
as anterior sucker
cp cirrus pouch
gp genital pore
i intestine
o ovary
oc eye-spot
os oral sucker

p pharynx
r rostellum
sg shell gland
t testis
u uterus
v excretory vesicle
vt vitellarium

21. A New Tapeworm (*Oochoristica ratti*) of the Family Anoplocephalidae from *Rattus rattus rattus* and *R. r. alexandrinus*

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(With Plate XXVI)

This tapeworm was first obtained by the junior author September 12, 1935, from the small intestine of *Rattus rattus alexandrinus* and *R. r. rattus* captured on board the " Shanghai Maru ". Subsequently it was found in 2.17 per cent of *R. r. alexandrinus* and in 9.38 per cent of *R. r. rattus* captured on board the Taiwan- and Shanghai-liners, always with higher frequency for the female rats than for the male. The number of worms found in a single host varies from three to nine.

As measured in life in physiological salt-solution, the body comprising 190–230 segments is usually 65–75 mm long, but may attain a length of 180 mm or more when relaxed. The scolex is rounded, 0.39–0.48 mm broad and bears four spherical suckers, 0.12–0.14 mm in diameter, in dorsal and ventral pair. The transparent apical center of the scolex may be produced into a tongue-shaped lobe in the fresh state, but there is no true rostellum. The neck is about 1.1 mm in length with a uniform breadth of 0.52 mm in a specimen 130 mm long, and 0.15 mm long by 0.7 mm broad in a contracted one. The immature anterior segments are much broader than long and become gradually longer posteriorly ; the fully mature segments are still broader than long, measuring 0.8–1.4 mm long by 1.35–2.0 mm broad ; the gravid segments, up to 3.5 mm long, are definitely longer than broad unless contracted, and some-what narrower than the broadest mature ones. The lateral margins of each segment are nearly parallel or slightly divergent posteriorly, so that they are not markedly salient at the posterior end. In contracted specimens, however, they may form a conspicuous serration.

The cuticle measures only 4–5 μ thick in transverse sections. The sub-cuticular musculature is poorly developed. The subcuticular cells form a thick compact layer. The inner longitudinal muscle bundles consisting of a relatively small number of fibers are separated from each other by an interval up to 65 μ in mature segments ; they are markedly atrophied in fully gravid segments. There is neither definite transverse nor dorsoventral musculature. The lateral nerve trunks lie just inside the inner longitudinal muscle sheath. The wide ventral excretory stem running on the ventral side of the vas deferens and vagina and immediately outside the ovary sends out side branches at irregular intervals ; the outer branches are connected with one another between the stem and the nerve trunk and form a secondary ventral stem, while the inner

branches communicate with the outer branches of the dorsal stem. The inner branches of the dorsal stem unite with one another and also with their fellows of the other side by transverse anastomoses, one of which lies near the posterior end of each segment and the other at the anterior end, the latter being much narrower and lacking sometimes. At the level of the anterior end of the suckers the ascending dorsal and descending ventral stems of one side communicate with their fellows of the other side and form a complete ring.

The small globular testes are massed in the posterior half of the segment in two lateral groups of 22–43 each, the total number being 48–84, and lie mostly in one layer and partly overlapping each other in the dorsal half of the medulla. They extend toward the median line behind the vitelline gland, and may be continuous there in fully mature segments, in which they overlap the ovary at its postero-lateral part. The twisted vas deferens lies in the dorsal medulla in front of the vagina and passes between the two excretory stems. The small elongated pyriform cirrus pouch, up to 0.15 mm long by 60 μ broad in the type, contains a convoluted ductus ejaculatorius at its base lying dorsal to the nerve trunk. It does not reach to the plane in which the two excretory stems are located. The cirrus opens immediately in front of the vagina into the well developed genital atrium, which in turn opens outside at about the middle of the anterior half of the lateral margin, irregulary on right or left.

The two-winged ovary, up to 0.8 mm broad in the type, consists of distally branched tubular lobules and lies in the pre-equatorial median field, with its transverse axis slightly oblique and leaving a moderately wide free space in front. The compact vitelline gland, up to 0.37 mm broad in the type, is finely lobed on the surface and lies in the midventral medulla near the posterior end of the segment. The shell gland complex is situated in the middorsal medulla immediately in front of the vitellarium. The receptaculum seminis is elongate, small and only 25 μ wide in a section of a mature segment. The vagina passes on the dorsal side of the ovary behind the vas deferens and then between the two excretory stems and dorsal to the nerve trunk. The uterus breaks up into innumerable capsules filling up the entire medulla and slightly intruding into the cortex in some places. Each capsule contains a single egg with a thin transparent outer shell 45–52 μ by 33–36 μ* and a thick embryonic shell 32–33 μ by 25–27 μ; the embryo measures 27–31 μ by 24–27 μ and the hooks are 15–16 μ long.

This species resembles *Oochoristica brasiliensis* Furhmann, 1927, more closely than any other known members of the genus, but differs from it in the number of testes and the host.

Oochoristica ratti n. sp.

SPECIFIC DIAGNOSIS. *Oochoristica* Lühe, 1899. Body up to 180 × 2 mm, comprising 190–230 segments. Scolex 0.39–0.48 mm broad. Suckers 0.12–

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*Measurements were made in water on specimens fixed in formol.

0.14 mm in diameter.   Excretory stems just outside ovary, with numerous side branches uniting with one another.   Transverse anastomoses between dorsal stems.   Testes 48–84 in number, in two lateral groups, may be continuous behind vitelline gland in fully mature segments.   Vas deferens and vagina between two excretory stems.   Cirrus pouch up to 0.15 mm long, not reaching to excretory stems.   Genital pores irregularly alternate, at about middle of anterior half of lateral margin.   Ovary branched distally, pre-equatorial.   Vitelline gland compact, with finely lobed surface.   Receptaculum seminis elongate, very small.   Vagina opening into genital atrium immediately behind cirrus pouch.   Egg capsules filling up entire medulla, each containing a single egg. Outer egg shell thin, transparent, 45–52×33–$36\,\mu$, embryonic shell thick, 32–33×25–$27\,\mu$; embryo 27–31×24–$27\,\mu$; embryonic hooks 15–$16\,\mu$ long.

Habitat.   Small intestine of *Rattus rattus alexandrinus* and *R. r. rattus*.
Locality.   Taiwan- and Shanghai-liners.
Type and paratypes in Yamaguti Helminthological Collection.

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EXPLANATION OF PLATE

XXVI

Fig. 1.   Two entire worms; right contracted, left extended.   Natural size.
Fig. 2.   Mature segment; dorsal view, $\times 30$.   *cp* cirrus pouch, *d* vas deferens, *n* nerve, *o* ovary, *t* testes, *vg* vagina, *vt* vitellarium.
Fig. 3.   Immature segment showing excretory system; ventral view, $\times 50$.   *vv* ventral vessel, *dv* dorsal vessel, *ta* transverse anastomosis.
Fig. 4.   Transverse section of gravid segment; $\times 35$.   *e* egg capsule, *il* inner longitudinal muscle.
Fig. 5.   Egg, $\times 750$.
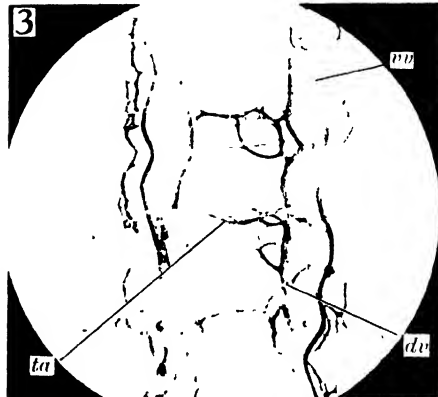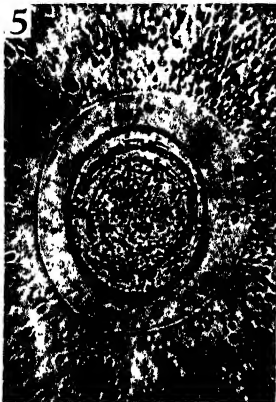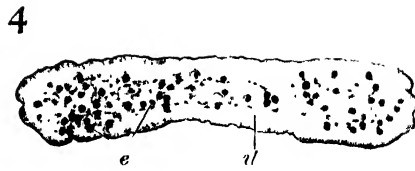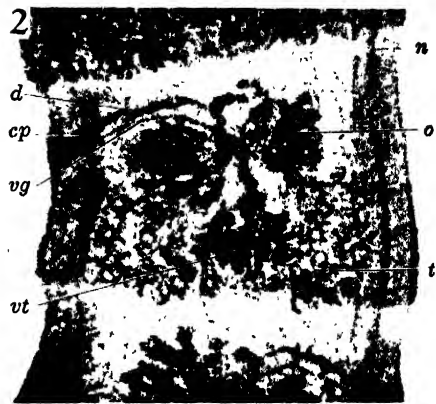
22. A New Trematode from *Amyda japonica* (Temm. et Schleg.)

By Satyû Yamaguti

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(With 1 Text-figure)

In Part 18 of the series of my studies on the helminth fauna of Japan I described two species of trematodes, *Astiotrema orientale* and *Kaurma longicirra* Chatterji, 1936, from the intestine of a tortoise, *Amyda japonica* (Temm. et Schleg.). The identification of Chatterji's species was based on immature specimens and therefore looked upon as provisional. Recently I have obtained several mature and numerous immature specimens from the same host species and found that they differed markedly in egg size from this Indian species, so that a new name *Kaurma orientalis* is proposed for my specimens, on which the following diagnosis is based.

Kaurma orientalis n. sp.

Body elongate oval in outline, rounded more broadly at posterior end than at anterior, 3.0–4.5 mm long when mature, with maximum breadth of 1.3–1.8 mm, covered on ventral surface with minute spines. Eye-spots and cervical glands present. Preoral lip 0.11–0.15 mm thick. Oral sucker 0.4–0.56 mm in diameter. Prepharynx and esophagus very short. Pharynx 0.2–0.25 × 0.22–0.3 mm. Ceca narrow, terminating near posterior extremity. Acetabulum 0.45–0.68 mm in diameter, at about middle of body. Testes irregularly lobed when mature, median, one immediately behind the other at about middle of posterior half of body; the anterior 0.25–0.55 × 0.5–0.8 mm, the posterior 0.37–0.7 × 0.53–0.75 mm. Cirrus pouch elliptical, preacetabular 0.53–0.75 × 0.188–0.4 mm. Vesicula seminalis tubular, looped, occupying greater part of cirrus pouch. Pars prostatica* tubular, well differentiated, up to about 0.25 × 0.063 mm. Prostatic cells well developed. Ductus ejaculatorius muscular, long, eversible into stout cirrus. Genital pore about midway between intestinal bifurcation and acetabulum, a little to left of median line. Ovary transversely elongated oval, 0.15–0.23 × 0.2–0.31 mm, median or a little to left (sometimes right) of median line immediately behind acetabulum. Germiduct arising from ventral surface of ovary, joining receptaculum seminis and Laurer's canal near its origin, Receptaculum seminis club- or retort-shaped, usually posterosinistral to ovary. Laurer's canal sinuous, opening on dorsal surface at varying levels (in left

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*In my emended diagnosis of the genus (p. 4) the pars prostatica was erroneously defined as undifferentiated.
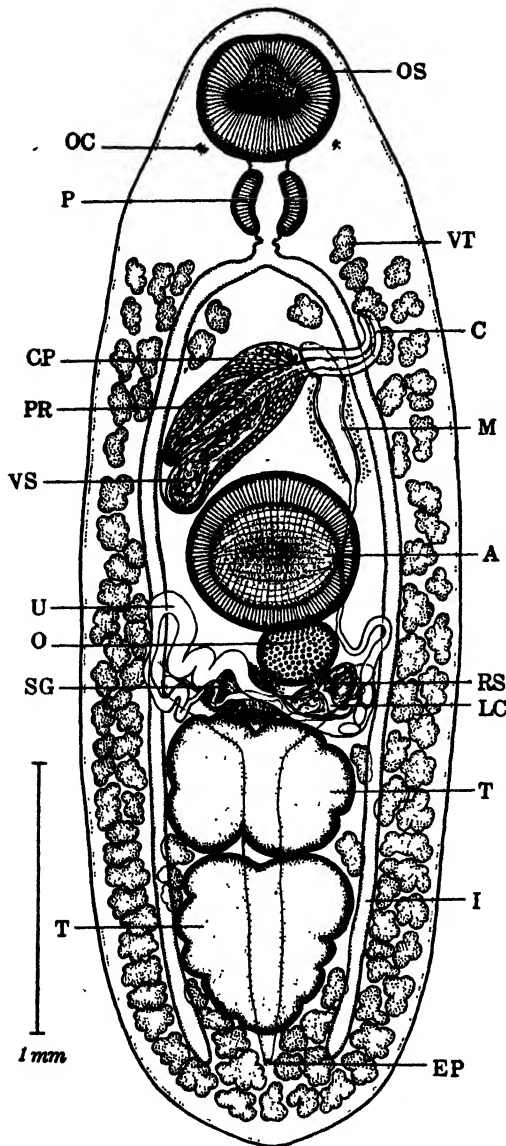
Kaurma orientalis; ventral view.

A	acetabulum	OS	oral sucker
C	cirrus	P	pharynx
CP	cirrus pouch	PR	pars prostatica
EP	excretory pore	RS	receptaculum seminis
I	intestine	SG	shell gland
LC	Laurer's canal	T	testis
M	metraterm	U	uterus
O	ovary	VS	vesicula seminalis
OC	eye-spots	VT	vitellarium

submedian line at level of posterior end of ovary in the type). Shell gland compact, between ovary and anterior testis. Uterus coiled on the right, then on the left, of ovary, reaching to ventral side of intestine on each side. Metraterm strongly muscular, surrounded by Begleitzellen, medial to left cecum. Eggs oval, thin-shelled, 87–105 × 60–69 μ in life. Vitellaria lateral to ceca for their entire length, partly medial to them, continuous across median line between excretory pore and posterior extremity. Vitelline reservoir median, anterodorsal to anterior testis. Excretory vesicle tubular, dorsal to testes, opening on middorsal surface at level of cecal ends, bifurcating into short widely divergent arms on dorsal side of anterior end of anterior testis. Collecting vessel arising from tip of each arm, divided into an anterior and a posterior tubule on ventral side of cecum of its own side at a level of posterior part of acetabulum or immediately behind it.

> Habitat. Small intestine of *Amyda japonica* (Temm. et Schleg.).
>
> Locality and date. Korea; May 5, 1937.
>
> Type and paratypes in Yamaguti Helminthological Collection.

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23. Drosophila Species of Japan and Adjacent Localities

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(With 29 Text-figures, 2 Tables and Plates XXVII–XXXII)

CONTENTS

I. Introduction

No comprehensive study of the Japanese species of *Drosophila* has been made, and our knowledge of this genus inhabiting the Japanese Islands outside Formosa is very fragmentary (Coquillett 1898, Duda 1922–1929, Esaki 1932, Kamizawa 1934, Kurisaki 1925, Matsumura 1931, Sturtevant 1921, 1927). This was the first cause which induced us to a systematic study of this group.

The second reason for making this attempt is that, with the progress of the works on the genetics of the *Drosophila* material obtained from Japan and adjacent localities, the data concerning the taxonomy and the geographic distribution of this group have gradually accumulated, Thus, it has become desirable to arrange them suitably. This paper is thus intended to be of some value not only to taxonomists, but also to geneticists, cytologists and other investigators of *Drosophila*.

This study has been made possible only by the favors and encouragement received from many different sources. It would not be possible to mention

here all those who have helped us. There are, however, several persons to whom our thanks are especially due. Professor T. Komai has kindly given us every facility for collecting the material, and much valuable advice and criticism in pursuance of this work. Dr. M. Chino and other members of our laboratory have supplied valuable information concerning our investigations. Professors A. H. Sturtevant and W. P. Spencer have sent us specimens of several living American species, properly named, and these have been very valuable for comparison with Japanese ones. Through the kindness of Drs. J. C. H. de Meijere and O. Duda, we have obtained many valuable papers concerning the taxonomy of Drosophilidae. Dr. R. Takahashi has furnished us the names of *Drosophila* species preserved in the Department of Agricultural Research Institute, Government of Formosa. We likewise acknowledge with gratitude the assistance of Mr. Y. Makino who made accurate drawings for this paper. The general style of the paper has been arranged by the senior author, and the studies of genital apparatus of each species have been investigated by the junior author.

II. Collection of material

Great effort has been made for several years to obtain as many specimens of *Drosophila* as possible. For our purpose, living material was especially desired. Therefore, many traps were sent to persons who live in various localities. For the trap, a bottle with a broad neck was employed. Ripe bananas, apples, peaches and other decaying fruits were placed on the bottom of the bottle, and stout string was tied around the bottle neck to facilitate its hanging in a convenient position on branches of trees, bushes, etc.

By this method the great majority of the specimens were collected. But a few species such as *D. transversa*, *D. bizonata* and *D. busckii* prefer fungi, sap or excrement to decaying fruits.

Except in special cases, the material thus brought into our laboratory was bred in a suitable culture-medium, and the offspring were examined carefully. In this paper, therefore, only the species which were studied on sufficient material from various view-points, are described. The species examined by the specimens preserved in alcohol or " pinned " material alone, are disregarded except in a few cases, because investigations based on such materials are rather unreliable.

III. Systematic accounts

For the sake of convenience, the method of classification now current among most taxonomists of *Drosophila* is used in this paper. The following represents the systematic position of *Drosophila*:

Class Insecta

Subclass Pterygota

Order Diptera
Suborder Cyclorrhapha
Family Drosophilidae
Genus *Drosophila*.

Since 1922, Duda has separated the genus *Drosophila* into a number of subgenera. Malloch has suggested that some of the species which Duda placed into *Mycodrosophila* should be transferred to *Drosophila*. But we do not wish to discuss the problem in detail here. As the result of examination of our material, we may include the following groups into the genus *Drosophila*: *Paradrosophila*, *Spinulophila* (*Acanthophila*) and typical *Drosophila*.

(1) Imagos

The structures of imago and the technical terms used in this paper, are shown by illustrations. In Plate XXVII is represented the schematic structure of *Drosophila komaii*.

According to Fallén (1823), the genus *Drosophila* is stated to have the following characteristics:

Head: Arista plumose; vibrissae and ocellars present; three orbitals, lowermost proclinate, upper two reclinate, middle one smaller than the others.

Thorax: One or more humerals; one presutural; two notopleurals; two supra-alars; two postalars; one to three sternopleurals; mesopleurae bare; two dorsocentrals; prescutellars generally absent; two pair of scutellars, disk of scutellum bare, posterior ones crossed; acrostichal hairs in six or more rows in front of transverse suture.

Leg: Preapicals evident at least on third tibiae.

Wing: Costa twice broken, reaches apex of fourth vein; discal and second basal cells confluent; anal cell present, often incomplete.

Though the above characteristics are not constant, they may be of use in deciding the genus. The most difficult point in classification is that there is no constant feature for distinguishing the species. For example, the acrostichal hairs between the anterior dorsocentrals, which are very convenient

Table 1

Number of rows of acrostichal hairs in some species of *Drosophila*

Rows of acrostichal hairs \\ Species	6	7	8	9	Total f
D. ananassae	7	4	39	0	50
D. melanogaster	0	3	58	1	62
D. rufa	3	6	17	0	31
D. sordidula	17	9	17	0	43
D. virilis	43	6	1	0	50

for classification, vary in rows in different individuals (Table 1). Similarly, the costal-index varies in individuals of the same species according to temperature. Therefore, as stated above, the identification must be based on sufficient investigations from various view-points.

The following key to species by imagos was chiefly made on the male specimens, because the characteristics of the female are less distinct than those of the male.

The general differences between the two sexes are: (1) The male is usually smaller than the female in both size and length. (2) In general, there are many long hairs which stand erect on tarsal joints of the prothoracic leg of male. But, these hairs are very small in number or quite absent in the female. (3) The external genital organs are distinctly different in the two sexes.

Key to species by the imagos

(1) A pair of small prescutellars present; blackish species (Pl. XXXI a)
　　　　　　　　　　　　　　　　　D. (*Paradrosophila*) *coracina* sp. nov. (p. 523)
　　No prescutellars...(2)
(2) A row of short black spinules, rather closely placed, on the apical half the antero-ventral surface of the fore femur in both sexes (PL. XXVII G)...........(3)
　　No such spinules ....(4)
(3) Reddish species; the greatest width of cheeks about one-tenth height of eye. In male, front silvery; pleurae pale yellow, with a distinct broad reddish brown stripe on each side (PL. XXVII A-H; Pl. XXXII)
　　　　　　　　　　　　　　　　　　D. (*Spinulophila*) *komaii* sp. nov. (p. 525)
　　Yellowish species; the greatest width of cheeks about one-third height of eye. In both sexes, front dull brownish yellow; wing clouded at tip of longitudinal veins and on posterior crossvein; A single bristle at tip of first costal section (Figs. 5, 6; Pl. XXXI b)
　　　　　　　　　　　　　　　　　　D. (*Spinulophila*) *immigrans* (p. 524)
(4) Acrostichal hairs in six rows..(5)
　　Acrostichal hairs in eight rows...(12)
(5) Yellowish species ....(6)
　　Blackish or brownish species ....(11)
(6) In male, mesonotum reddish brown, with four distinct yellow stripes; pleurae black; coxa of prothoracic leg black; large species (Pl. XXXI c)
　　　　　　　　　　　　　　　　　　　　　　　　D. grandis sp. nov. (p. 543)
　　Mesonotum unmarked ....(7)
(7) Abdomen spotted ....(8)
　　Abdomen banded ....(9)
(8) Wings clouded at the tip and on both crossveins (Pl. XXXI d)
　　　　　　　　　　　　　　　　　　　　D. nigromaculata sp. nov. (p. 537)
　　Wing clear (Fig. 24)
　　　　　　　　　　　　　　　　　　　　　　　　　D. transversa (p. 537)
(9) In male, two oblique combs of short black bristles on the inner surface of basal tarsal joint of prothoracic leg; a few stout black bristles on the distal part of second tarsal joint of the same leg; very small species (Figs. 9, 10)
　　　　　　　　　　　　　　　　　　　　　　　　　D. bipectinata (p. 527)
　　In male, several transverse rows of blackish brown bristles on the ventral surface of the first and second tarsal joints of prothoracic leg. The bristles of these rows

become yellowish in color as they approach the base of joint (Figs. 7, 8; Pl. XXXI e)

D. ananassae (p. 526)

In male, no marked combs on the tarsal joints of prothoracic leg (Pl. XXXI f)

D. bizonata sp. nov. (p. 532)

In male, very distinct black combs on the first and second tarsal joints of prothoracic leg ....(10)

(10) Pleurae of male yellow, with a broad dark-brownish stripe on each side (Figs. 12, 13)

D. rufa sp. nov. (p. 529)

Pleurae of male unmarked; face snowy white; last abdominal segment black in color (Fig. 11; Pl. XXXI g)

D. auraria (p. 528)

Pleurae of male unmarked; face pale yellow; last abdominal segment yellowish brown in color; the number of teeth in the comb of first tarsal joint is over 20 (Fig. 14)

D. montium (p. 530)

Pleurae of male yellow; face yellow; last abdominal segment yellow in color; the number of teeth in the comb of first tarsal joint is less than 20 (Fig. 15)

D. nipponica sp. nov. (p. 531)

(11) Only one prominent oral bristle; a few prominent bristles on each palpus; the greatest width of cheeks about one-fifth height of eye; abdominal bands of female not interrupted; wing somewhat dusky; large species (Fig. 25; Pl. XXXI h)

D. sordidula sp. nov (p. 539)

The ratio of second oral bristle to first, irregular, but less than 1.0; a few prominent bristles on each palpus; the greatest width of cheeks about one-fourth height of eye; abdominal bands of female generally interrupted in the middle and lateral parts; wing slightly brownish (Pl. XXXI j)

D. melanissima (p. 538)

Second oral bristle about one-half length of first; only one prominent bristle on each palpus; the greatest width of cheeks about one-third height of eye; abdominal bands of both sexes are not interrupted; wing clear (Fig. 26; Pl. XXXI k; Pl. XXXII)

D. virilis (p. 540)

(12) Mesonotum gray, with many dark brownish spots (Fig. 29; Pl. XXXI i)

D. repleta (p. 544)

Mesonotum, pleurae yellow, with several distinct dark-brownish stripes; face whitish in color (Fig. 27)

D. buscku (p. 541)

Mesonotum not distinctly marked or unmarked ....(13)

(13) Yellowish or reddish species ....(14)

Blackish or brownish species ....(18)

(14) A blackish spot present in the tip of wing (Fig. 23; Pl. XXXI l; Pl. XXXII)

D. suzukii (p. 536)

Wing clear ....(15)

(15) No marked combs on the tarsal joints of prothoracic leg of the male; abdomen yellow with a dark brownish band on each of the four basal segments, which is interrupted in the mid-dorsal part; very large species (Pl. XXXI m)

D. histrio (p. 544)

In male, an oblique comb of short stout black bristles on the inner distal surface of the basal tarsal joint of prothoracic leg (Figs. 20, 21; Pl. XXXI n)

D. melanogaster (p. 534)

The eye is larger than that of *melanogaster*; genital arch of the male is distinctly different from that of *melanogaster* (Fig. 22)

D. simulans (p. 536)

In male, several transverse rows of blackish brown bristles on the ventral surface

of the first and second tarsal joints of prothoracic leg. The bristles of these rows become yellowish in color as they approach the base of joint (Figs. 7, 8; Pl. XXXI e)

                                                                    D. ananassae (p. 526)

In male, two oblique combs of short, stout black bristles on the inner surface of the basal tarsal joint of prothoracic leg; a few stout black bristles on the distal part of the second tarsal joint of the same leg; very small species (Figs. 9, 10)

                                                                    D. bipectinata (p. 527)

In male, two transverse combs of a few stout black bristles on the undersurface of the basal tarsal joint of prothoracic leg; similar combs on the same surface of the second tarsal joint ....(16)
Two longitudinal combs of stout black bristles on the first and second tarsal joints of prothoracic leg ....(17)
(16) There is a blackish spot in the groove located on the posterior base of the coxa of the prothoracic leg (Figs. 17, 18; Pl. XXXI p)

                                                                    D. lutea sp nov. (p. 533)

No such blackish spot (Fig. 19; Pl. XXXI o)

                                                                    D. takahashii (p. 534)

(17) Ground color of mesonotum yellow, but somewhat brownish yellow at the base of wing; the sex comb of the second tarsal joint overlaps the third one; 4V-index is less than 2.0 (Fig. 16; Pl. XXXI q)

                                                                    D. ficusphila sp. nov. (p. 531)

Ground color of mesonotum yellow; but in male, there is a broad dark-brownish stripe on each side of pleurae (Figs. 12, 13)

                                                                    D. rufa sp. nov. (p. 529)

(18) Wing clear; brownish species (Fig. 28)

                                                                    D. funebris (p. 542)

Wing dusky ....(19)
(19) Only one prominent oral bristle; carina broad, halteres pale brown (Fig. 25; Pl. XXXI h)

                                                                    D. sordidula sp. nov. (p. 539)

Second oral bristle about one-half length of the first; carina narrow; halteres white; wing pointed at the tip (Pl. XXXI r; Pl. XXXII)

                                                                    D. subtilis sp. nov. (p. 541)

(2) Eggs

All the species investigated, lay white eggs varying from 0.35 to 0.55 mm in length, with a fine meshwork of raised lines over their surfaces. The structures of filaments at the anterior end are different in number and shape in different species, and afford excellent specific characters.

Key by eggs

(1) Eight or nine filaments (Fig. 1 A)

                                                                    D. coracina

Two filaments..(2)
Three filaments ....(3)
Four filaments... ....(4)
(2) Tip of the filaments, rather rounded.

D. ananassae, D. bipectinata, D. lutea, D. melanissima, D. melanogaster (Fig. 1 C), *D. simulans, D. takahashii* (Fig. 1 B)

Tip of the filaments, tapering.

D. auraria, D. ficusphila, D. montium (Fig. 1 D), *D. rufa, D. suzukii*

(3) Median filament thicker than either of the two lateral ones.

D. transversa (Fig. 1 E)

(4) Four filaments.

D. bizonata, D. busckii, D. funebris, D. grandis, D. immigrans, D. komaii (Fig. 1 F), *D. repleta, D. sordidula, D. subtilis, D. virilis.*

Species not examined: *D. histrio, D. nigromaculata, D. nipponica.*
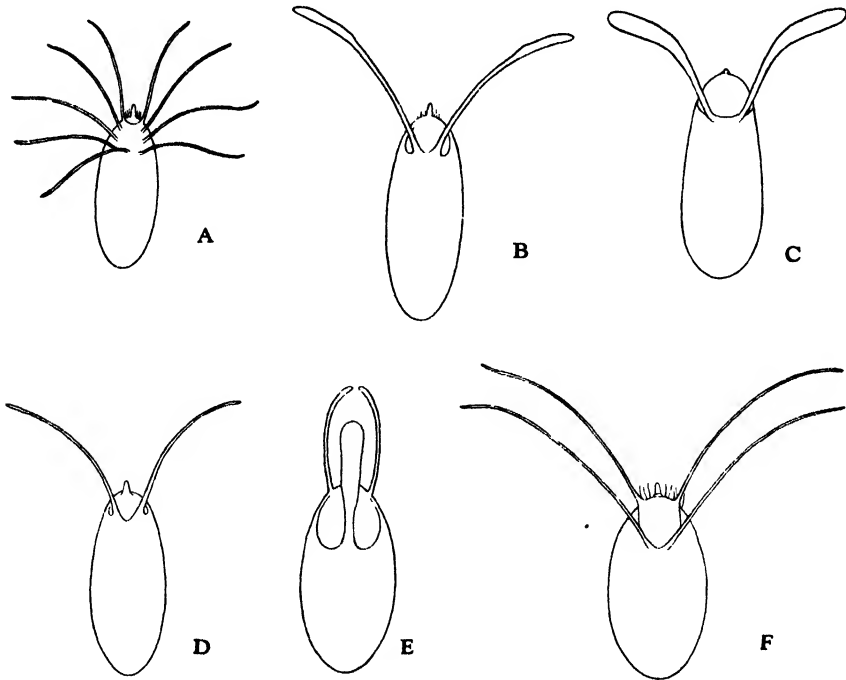
Fig. 1. Eggs of *Drosophila* species.
A, *D. coracina,* B, *D. takahashii,* C, *D. melanogaster,* D, *D. montium,*
E, *D. transversa,* F, *D. komaii.*

(3) Larvae

According to Keilin (1915), the larvae of *D. melanogaster* pass through three stages, separated by two larval molts. We have not examined the two younger stages, nor studied the transitions between them. The following accounts all apply to the third larvae.

The body is divided into twelve visible segments (Fig. 2). The first segment bears a pair of cephalopharyngeal skeletons (jaws) and anterior spiracle processes. Although no study has been made here, they are certainly very useful for specific distinction (de Meijere 1916, Sturtevant 1921).

There are minute hooklets (warts) scattered over the surface of the larva, but these are not easily seen except in eight bands of several rows, which lie on the ventral surface of the larva, at the anterior edge of each abdominal segment (Fig. 2, Pl. XXX a b).

The hooklets of some species are blackish in color, but those of other ones are colorless or slightly tinged; and these afford excellent taxonomic characters. There are several processes (pseudopodia) on the last segment. From the upper posterior part of this segment arise the posterior spiracle processes. The color of these processes in most species is yellow or reddish yellow, but black in *D. immigrans*.

The fully grown larvae of *D. coracina* and of *D. subtilis* skip in the same way as do those of *Piophila* and a few other Acalypterae. Sturtevant (1921) has also observed a similar behavior in the larvae of *D. cardini* and *D. saltans*.
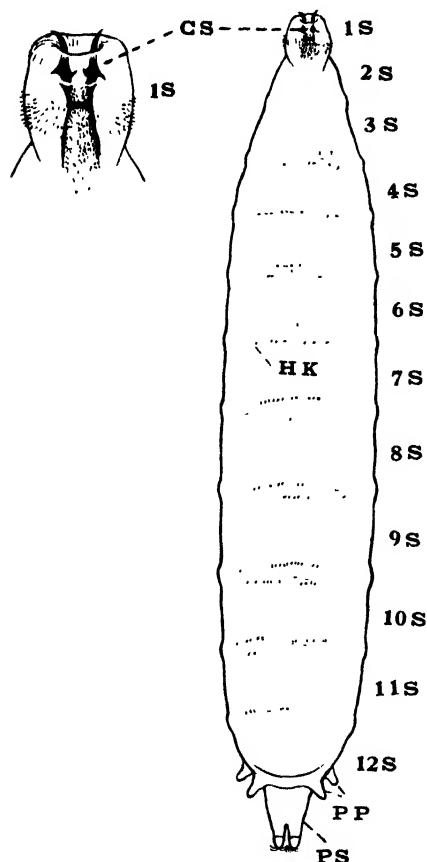
Fig. 2. Ventral view of the third larva of *D. melanogaster*.
1S–12S = First segment-Twelfth segment
CS = Cephalopharyngeal skeletons (jaws)
HK = Hooklets (warts), PP = Pseudopodia
PS = Posterior spiracle processes

Key by larvae

(1) Tip of the posterior spiracles black in color.

D. immigrans

Tip of the posterior spiracles yellow or reddish yellow in color..............(2)

(2) About six large branched processes on the dorsal surface of each segment from the fourth to the twelfth.

D. busckii

No such large processes ....(3)
(3) Hooklets on the ventral surface blackish in color.

> D. ananassae, D. auraria, D. bipectinata, D. ficusphila, D. lutea, D. melanogaster (Fig. 2; Pl. XXX a b), D. montium, D. rufa, D. simulans, D. subtilis, D. suzukii, D. takahashii

Hooklets on the ventral surface, colorless or tinged slightly.

> D. bizonata, D. coracina, D. funebris, D. komaii, D. melanissima, D. nigromaculata, D. repleta (brown), D. sordidula (slightly yellow), D. transversa, D. virilis

Species not examined: D. grandis, D. histrio, D. nipponica.

(4) Pupae

Descriptions or figures of puparia of *Drosophila* have been published by the following authors; Comstock (1893), Howard (1900), Unwin (1907), Malloch (1915), Strasburger (1935) etc.

Drosophila, like other cyclorrhaphous Diptera, pupates within the last larval skin. The anterior spiracles are extruded to form the horns of the puparium. The length of the stalk of horns in proportion to the total length of the body (hereafter designated as SB), and the number of anterior spiracles (designated as NA), are different according to the species. In Figure 3, are shown several examples of the anterior parts of pupae.
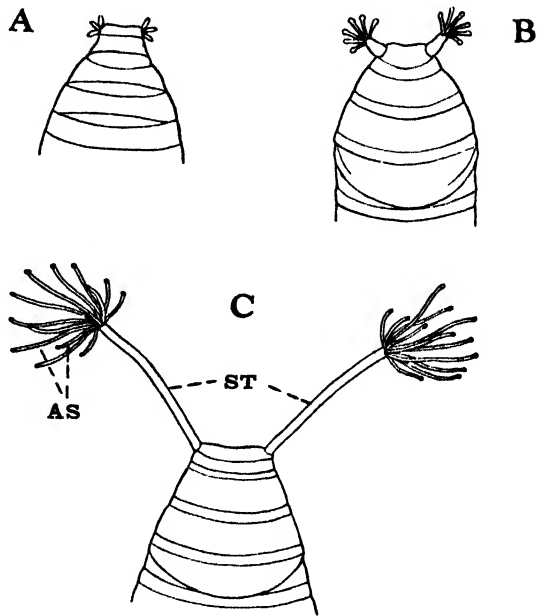
Fig. 3. Anterior parts of pupae of *Drosophila* species. A, *D. coracina*, B, *D. melanogaster*, C, *D. immigrans*. (AS=Anterior spiracles, ST=Stalk of horns).

The characteristics of the posterior spiracles and of the ventral hooklets (also the dorsal process of *D. busckii*) of the larvae are retained in the puparium. The classification according to these structures are as follows:

Key by Pupae

(1) Tip of the posterior spiracles black in color; hooklets blackish.

> *D. immigrans* (SB=ca. 1/3; NA=ca. 15; Fig. 3 C)

Tip of the posterior spiracles, yellow or reddish yellow in color..............(2)

(2) Large branched processes on the dorsal surface of each segment from the fourth to the twelfth.

> *D. busckii* (SB=ca. 1/15; NA=ca. 10)

No such processes .... (3)
(3) The posterior spiracles are closed at the tip.

   D. coracina (No marked stalk; NA=ca. 4; Fig. 3 A), *D. melanissima* (SB=ca.
   1/18; NA=ca. 10), *D. repleta* (SB=ca. 1/18; NA=ca. 16), *D. subtilis* (SB=ca.
   1/40; NA=ca. 6)

The posterior spiracles are divergent at the tip.

   D. ananassae (SB=ca. 1/20; NA=ca. 10), *D. auraria* (SB=ca. 1/15; NA=ca.
   10), *D. bipectinata* (SB=ca. 1/15; NA=ca. 10), *D. bizonata* (SB=ca. 1/5; NA
   =ca. 15), *D. ficusphila* (SB=ca. 1/10; NA=ca. 12), *D. funebris* (SB=ca. 1/11;
   NA=ca. 20), *D. komaii* (SB=ca. 1/2; NA=ca. 18), *D. lutea* (SB=ca. 1/16;
   NA=ca. 6), *D. melanogaster* (SB=ca. 1/25; NA=ca. 7; Fig. 3 B), *D. montium*
   (SB=ca. 1/12; NA=ca. 10), *D. nigromaculata* (SB=ca. 1/12; NA=ca. 6), *D.*
   rufa (SB=ca. 1/16; NA=ca. 10), *D. simulans* (SB=ca. 1/25; NA=ca. 6), *D.*
   sordidula (SB=ca. 1/6; NA=ca. 12), *D. suzukii* (SB=ca. 1/20; NA=ca. 8),
   D. takahashii (SB=ca. 1/16; NA=ca. 8), *D. transversa* (SB=ca. 1/12; NA=
   ca. 10), *D. virilis* (SB=ca. 1/30; NA=ca. 15)

Species not examined: *D. grandis, D. histrio, D. nipponica.*

(5) Internal characters

(A) Chromosomes

In Plate XXVIII and the following list, are shown the female-chromosome
types of *Drosophila* species which thus far have been studied by various workers.
The Japanese species described in this paper are indicated by Gothic letters.
The sex-chromosomes, if known, are described in the table. A detailed state-
ment on this problem will be published elsewhere.

As pointed by many cytologists on both animals and plants, the chromo-
some types are very useful for distinguishing the varieties, subspecies or
the closely related species. The principal references on this problem are as
follows :

Dobzhansky, Th. (1935) Genetics, 20: 367–376, 377–391.
Frolowa, S. L. (1926) Zeitschr. Zellforsch., 3: 682–694.
Frolowa, S. L. (1930) *Ibid.* 10: 214–220.
Frolowa, S. L., and B. L. Astaurow (1930) *Ibid.* 10: 201–213.
Heitz, E. (1933) *Ibid.* 20: 237–287.
Katayama, H., and H. Kikkawa (1937) Jap. Journ. Genet., 13: 6–8.
Kikkawa, H. (1936) *Ibid.* 12: 137–142.
Metz, C. W., and M. S. Moses (1923) Journ. Hered., 14: 195–204.
Morgan, T. H., C. B. Bridges and A. H. Sturtevant (1925) Bibliogr.
      Genetica, 2: 1-262.
Sturtevant, A. H., and Th. Dobzhansky (1936) Amer. Nat., 70: 574–584.

List of types of female-chromosomes

A-type (Pl. XXVIII, A)
   D. auraria Peng (X=rod, Y=small rod), *D. bromeliae* Sturtevant, *D. busckii* Coquillett,
   D. ficusphila sp. nov., *D. florae* Sturtevant, *D. lutea sp. nov.* (X=rod, Y=small rod), *D.*

melanogaster Meigen (X=rod, Y=J-shaped), *D. nebulosa* Sturtevant, *D. coracina sp. nov.*, *D. quinaria* Loew, *D. robusta* Sturtevant, *D. rufa sp. nov.* (X=rod), *D. saltans* Sturtevant, *D. simulans* Sturtevant (X=rod, Y=small rod or J-shaped), *D. suzukii* (Matsumura), *D. takahashii* Sturtevant (X=rod, Y=small rod), *D. vibrissina* Fallén, *Chymomyza amoena* Loew, *C. procnemis* Williston, *Mycodrosophila dimidiata* Loew, *Scaptomyza graminum* Fallén.

B-type (Pl. XXVIII, B)

D. earlei Sturtevant, *D. willistoni* Sturtevant (X=V-shaped, Y=rod).

C-type (Pl. XXVIII, C)

D. calloptera Schiner, *Scaptomyza adusta* Loew.

D-type (Pl. XXVIII, D)

D. immigrans Sturtevant (X=rod), *D. komaii sp. nov.* (X=rod).

E-type (Pl XXVIII, E)

D. melanica Sturtevant, *D. melanissima* Sturtevant, *D. sordidula sp. nov.* (X=V-shaped), *D. trivittata* Strobl.

F-type (Pl. XXVIII, F)

D. cardini Sturtevant, *D. mulleri* Sturtevant, *D. phalerata* Meigen (X=rod, Y=rod), *D. ramsdeni* Sturtevant, *D. similis* Williston (X=rod), *D. transversa* Fallén (X=rod), *D. tripunctata* Loew, *D. virilis* Sturtevant (X=rod, Y=rod).

G-type (Pl. XXVIII, G)

D. funebris Fabricius (X=long rod, Y=long rod), *D. histrio* Meigen.

H-type (Pl. XXVIII, H)

D. bizonata sp. nov. (X=V-shaped), *Cladochaeta nebulosa* Coquillett.

I-type (Pl. XXVIII, I)

D. hydei Sturtevant (X=V-shaped, Y=rod), *D. repleta* Wollaston (X=V-shaped, Y=rod).

J-type (Pl. XXVIII, J)

D. miranda Dobzhansky (Xs=V- and rod-shaped, Y=small V-shaped), *D. pseudoobscura* Frolowa & Astaurow (X=V-shaped, Y=various types).

K-type (Pl. XXVIII, K)

D. affinis Sturtevant (X=V-shaped, Y=J-shaped), *D. algonquin* Sturtevant & Dobzhansky (X=V-shaped, Y=J-shaped, the V-shaped autosomes of *D. affinis* are replaced with the J-shaped ones), *D. athabasca* Sturtevant & Dobzhansky (the same), *D. azteca* Sturtevant & Dobzhansky (the same).

L-type (Pl. XXVIII, L)

D. ananassae Doleschall (*D. caribbea* Sturtevant) (X=long V-shaped, Y=rod or J-shaped), *D. bipectinata* Duda.

M-type (Pl. XXVIII, M)

D. montium Race A de Meijere (X=rod, Y=small V-shaped).

N-type (Pl. XXVIII, N)

D. montium Race B de Meijere (X=rod, Y=small V-shaped).

O-type (Pl. XXVIII, O)

D. subtilis sp. nov.

P-type (Pl. XXVIII, P)

D. sulcata Sturtevant (X=large V-shaped, Y=large V-shaped).

Q-type (Pl. XXVIII, Q)

D. obscura Fallén

(B) Structures of testes

The penis of *Drosophila* is a chitinized tube, differing greatly in shape from species to species, but we have not made any detailed investigation on it. The structures of testes, however, were studied to some extent. They are usually cylindrical and coiled, but are ellipsoidal in *D. coracina*. In Figure 4 are shown several kinds of testes.
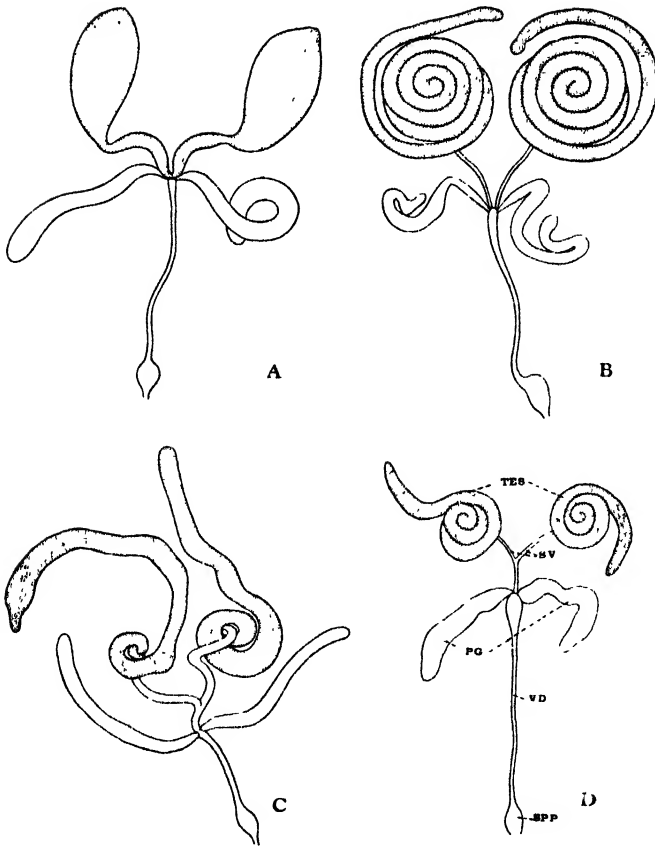
Fig. 4. Structures of testes of some species of *Drosophila*.
A, *D. coracina*, B, *D. repleta*, C, *D. subtilis*, D, *D. auraria*.
PG=Paragonia, SPP=Sperm pump, SV=Seminal vesicles, TES=Testes,
VD=Vas deferens.

(C) Other internal structures

Sturtevant (1921) has investigated the forms of spermathecae of various species of Drosophilidae, and has given many useful figures (pp. 36–37). Of those figures, the following may be applicable to the Japanese species: *D. busckii*, *D. ananassae* (*D. caribbea*), *D. funebris*, *D. immigrans*, *D. melanogaster*, *D. repleta*, *D. transversa*, *D. virilis*.

As stated before, the structures of cephalopharyngeal skeletons of third-stage larvae are extraordinarily dependable and definite specific characters (de Meijere 1915, Sturtevant 1921). But no comprehensive study has yet been made of the Japanese species.

IV. Ecological accounts

(1) Geographic distribution

Drosophila species and their habitats cleared up by the ways described in Chapter II, are shown in Plate XXIX and Table 2.

Table 2

Geographic distribution (See also Pl. XXIX)

1. Ôtomari (A, B) (T. Urita, Oct. 1935) *D. funebris, D. virilis.*
2. Rebun-Tô (B) (S. Emura, Aug. 1937) *D. virilis.*
3. Risiri-Tô (B) (S. Emura, Aug. 1937) *D. virilis.*
4. Tesikaga (B) (T. Komai, Sept. 1935) *D. immigrans, D. virilis.*
5. Akkesi (B) (Y. Haneda, July, 1934) *D. funebris, D. virilis.*
6. Kamikawa (B) (T. Komai, Sept. 1935) *D. virilis.*
7. Sapporo (B) (S. Makino, July 1934) *D. funebris, D. virilis.* (S. Makino, Sept.-Oct. 1934) (Preserved in alcohol) *D. busckii, D. histrio, D. nigromaculata, D. sordidula.* (S. Makino, Oct. 1935) *D. nigromaculata.* (H. Kikkawa, Aug. 1937) *D. virilis.*
8. Hirosaki (B) (T. Ishihata, Aug. 1935) *D. virilis.*
9. Akita (B) (A. Seki, Oct. 1934) *D. virilis.* (A. Seki, June, 1935) *D. auraria.*
10. Innai (B) (T. Takaku, T. Itô and G. Yamamoto, Sept. 1937) *D. busckii, D. lutea, D. sordidula, D. virilis.*
11. Sendai (B) (S. Hôzawa, June, 1935) *D. auraria, D. immigrans, D. lutea.*
12. Sado (B) (S. Watanabe, Oct. 1934) *D. immigrans, D. lutea, D. sordidula.*
13. Niigata (B) (K. Ikeda, Aug. 1934) *D. auraria, D. busckii, D. immigrans, D. virilis.* (K. Ikeda, Oct. 1934) *D. busckii, D. immigrans, D. lutea, D. virilis.* (S. Emura, Sept. 1934) *D. immigrans, D. virilis.*
14. Kanazawa (B) (H. Kawashima, July 1934) *D. busckii, D. lutea, D. virilis.*
15. Nagano (B) (H. Nakano, Oct. 1934) *D. lutea.*
16. Kamisuwa and adjacent localities (B) (M. Chino, various seasons, 1923-1933) *D. auraria, D. busckii, D. immigrans, D. lutea, D. melanogaster, D. sordidula, D. virilis.* (M. Shimizu, Sept. 1934) *D. immigrans.*
17. Kôhu (B) (T. Kamizawa and M. Hiraga, Sept. 1934) (Preserved in alcohol) *D. auraria, D. busckii, D. ficusphila, D. grandis, D. melanogaster, D. suzukii, D. transversa,* (*Amiota variegata*). (M. Hiraga, Dec. 1935) (Preserved in alcohol) *D. busckii, D. histrio, D. immigrans, D. lutea, D. rufa, D. transversa, D. virilis,* (*Amiota variegata*).
18. Tôkyô (B) (D. Moriwaki, July 1931) *D. ananassae, D. virilis.* (D. Moriwaki, Jan. 1937) (Preserved in alcohol) *D. repleta.*
19. Titizima (H) (K. Daidô, Oct. 1936) *D. melanogaster, D. simulans.*
20. Hahazima (H) (K. Daidô, Dec. 1936) *D. ananassae, D. melanogaster, D. simulans.*
21. Naka-Iwôtô (H) (K. Daidô, Dec. 1936) *D. ananassae, D. melanogaster.*
22. Gotenba (B) (T. Komai, Aug.-Sept. 1934-1937) *D. auraria, D. busckii, D. immigrans, D. lutea, D. melanogaster, D. sordidula, D. subtilis, D. suzukii, D. transversa, D. virilis,* (*Amiota variegata*).
23. Sizuoka and adjacent localities (B) (T. Noguti, Oct. 1936) *D. immigrans, D. lutea.* (H. Kobayashi, Oct. 1936) *D. lutea, D. melanogaster.*
24. Simoda (B) (H. Niiyama and H. Katayama, Nov. 1935) *D. coracina, D. immigrans, D. lutea, D. montium.* (T. Tokioka, Oct. 1936) *D. lutea, D. melanogaster, D. montium B, D. subtilis.*
25. Yaizu (B) (T. Teramoto, Dec. 1936) *D. immigrans, D. lutea.*
26. Gihu (B) (F. Ishitani, June 1935) *D. immigrans, D. lutea, D. virilis.*
27. Nagoya (B) (Y. Niwa, July 1934) *D. auraria, D. immigrans.*

28. **Ayabe** (B) (S. Kôno. July 1934) *D. auraria, D. virilis.* (H. Kikkawa, July 1936) *D. auraria, D. lutea, D. nigromaculata, D. nipponica, D. virilis.*

29. **Kyôto** (B) (M. Chino, H. Kikkawa and F. T. Peng, various seasons, 1930-1937) *D. auraria, D. bizonata, D. busckii, D. coracina, D. ficusphila, D. grandis, D. immigrans, D. lutea, D. melanissima, D. melanogaster, D. nigromaculata, D. rufa, D. sordidula, D. subtilis, D. suzukii, D. transversa, D. virilis, (Amiota variegata).*

30. **Kitazato** (B) (J. Ikari, July 1934) *D. virilis.*

31. **Tu** (B) (F. Ohmachi, July 1934) *D. busckii, D. immigrans, D. virilis.*

32. **Kukasyô** (B) (K. Higashi, July 1934) *D. auraria, D. immigrans, D. virilis.*

33. **Ôsaka** (B) (H. Kikkawa, Dec. 1936) *D. repleta.*

34. **Sizyônawate** (B) (T. Furuguchi, July 1934) *D. auraria, D. virilis.*

35. **Nara** (B) (K. Onoda, Oct. 1934) *D. melanogaster.*

36. **Yuasa** (B) (M. Kurisaki, Oct. 1936) *D. melanogaster, D. montium B.*

37. **Seto** (B) (I. Taki, Aug. 1926) *D. melanogaster.* (H. Kikkawa, Aug. 1932) *D. melanogaster.*

38. **Katuura** (B) (K. Onoda, Sept. 1934) *D. ficusphila, D. melanogaster.*

39. **Asiya** (B) (M. Tokuda, May 1935) *D. immigrans, D. lutea, D. rufa.*

40. **Kôbe** (B) (H. Kikkawa, June 1934) *D. auraria, D. immigrans, D. lutea, D. melanissima, D. melanogaster, D. subtilis, D. transversa, D. virilis.* (H. Kikkawa, Oct. 1934) *D. bizonata, D. transversa.*

41. **Himezi** (B) (R. Abe, July 1934) *D. auraria, D. melanogaster, D. virilis.*

42. **Tottori** (B) (S. Inomata, July 1934) *D. immigrans, D. virilis.*

43. **Oki** (B) (K. Fukushima, Oct. 1934) *D. busckii, D. immigrans, D. lutea.*

44. **Kurasiki** (B) (C. Harukawa, July 1934) *D. auraria, D. immigrans.* (C. Harukawa, Aug. 1934) *D. auraria.*

45. **Hirosima** (B) (S. Hareyama, July 1934) *D. immigrans, D. melanogaster, D. virilis.*

46. **Tokuyama** (B) (T. Hiro, July 1934) *D. busckii, D. immigrans, D. montium, D. virilis.*

47. **Kwannonzi** (B) (H. Shimizu, Aug. 1934) *D. melanogaster.*

48. **Matuyama** (B) (I. Taki, July 1926) *D. montium B.* (T. Ôue, May 1935) *D. auraria. D. immigrans, D. lutea, D. virilis.*

49. **Kôti** (B) (T. Kamohara, July 1934) *D. auraria, D. virilis.* (T. Kamohara, Oct. 1936) *D. lutea, D. virilis.* (T. Kamohara, Dec. 1936) *D. immigrans, D. virilis.*

50. **Hukuoka** (B) (T. Esaki, Aug. 1934) *D. melanogaster, D. montium, D. virilis.*

51. **Yanagawa** (B) (M. Kinoshita, July 1934) *D. melanogaster, D. virilis.*

52. **Saga** (B) (H. Fukuda, Aug. 1934) *D. virilis.*

53. **Kawatana** (B) (K. Hayashi, Oct. 1933) (Preserved in alcohol) *D. melanogaster, D. montium.*

54. **Waihu** (B) (K. Ishikawa, July 1934) *D. busckii, D. melanogaster, D. virilis.*

55. **Ôita** (B) (N. Andô, Oct. 1936) *D. immigrans, D. lutea. D. montium A., D. rufa, D. suzukii.*

56. **Kumamoto** (B) (N. Takahashi, Aug. 1934) *D. melanogaster.*

57. **Tomioka** (B) (K. Baba, Sept. 1934) *D. melanogaster, D. montium A.* (K. Baba, Nov. 1936) *D. immigrans, D. melanogaster, D. montium A.*

58. **Miyazaki** (B) (J. Kitao, July 1934) *D. melanogaster, D. virilis.* (J. Kitao, Oct. 1936) *D. auraria, D. lutea, D. melanogaster.*

59. **Miyanozyô** (B) (T. Amase, Aug. 1937) *D. montium, D. virilis.*

60. **Kagosima** (B) (K. Hino and M. Kubo, Aug. 1934) *D. melanogaster, D. virilis.*

61. **Sibusi** (B) (T. Satô, July 1934) *D. melanogaster.*

62. **Amami-Ôsima** (C) (H. Ôba, June 1935) *D. busckii.* (H. Ôba, Oct. 1936) *D. ananassae, D. komaii, D. melanogaster, D. montium, D. repleta.*

63. **Naha and adjacent localities** (C) (D. Nakamura, March 1933) *D. repleta.* (T. Tôma, Oct. 1934) *D. ananassae, D. melanogaster, D. montium A.* (T. Tôma, Oct. 1936) *D. ananassae, D. melanogaster.* (K. Nakamura, July 1937) *D. ananassae, D. montium.*

64. **Isigakizima** (C) (T. Iwasaki and J. Masaki, Oct. 1934) *D. ananassae, D. bipectinata, D. komaii, D. montium A.* (J. Masaki, Nov. 1936), *D. melanogaster.* (K. Nakamura,

July 1937) *D. ananassae, D. melanogaster, D. repleta.*

65. Kyôzyô (D) (S. Ôta. July 1937) *D. melanogaster.*
66. Syuotu (D) (M. Tokuda, Oct. 1936) (Preserved in alcohol) *D. busckii, D. melanogaster.*
67. Kankô (D) (B. Nomura, July 1937) *D. virilis.*
68. Syunsen (D) (D. Sai, July 1937) *D. melanogaster, D. virilis.*
69. Keizyô (D) (Y. Umeya, July 1934) *D. busckii, D. melanogaster, D. montium?, D. sordidula, D. transversa, D. virilis.* (T. Mori, June 1935) *D. busckii, D. melanogaster, D. virilis.*
70. Port-Arthur (E) (S. Komori, Oct. 1934) *D. immigrans, D. melanogaster, D. montium?, D. takahashii.*
71. Taihoku (F) (Y. Horikawa, Dec. 1924) *D. repleta.* (T. Komai, Aug. 1932) *D. ananassae, D. bipectinata, D. komaii, D. melanogaster.* (R. Takahashi, Oct. 1934) *D. ananassae, D. bipectinata, D. komaii, D. melanogaster, D. takahashii.* (R. Takahashi, Dec. 1934) *D. ananassae, D. bipectinata, D. immigrans, D. melanogaster, D. montium A, D. takahashii.* (T. Shiraki, Oct. 1934) *D. ananassae, D. bipectinata, D. komaii, D. montium A, D. takahashii.* (N. Omori, Oct. 1934) *D. ananassae, D. bipectinata, D. komaii, D. takahashii.* (S. Aota, Oct. 1934) *D. ananassae.* (S. Aota, Dec. 1934) *D. repleta.* (M. Chino, Dec. 1934) *D. ananassae, D. bipectinata, D immigrans, D. komaii, D. melanogaster, D. repleta.* (K. Koidsumi, Dec. 1934) *D. bipectinata, D. immigrans, D. komaii, D. melanogaster, D. takahashii.* (R. Takahashi, Oct. 1936) *D. bipectinata, D. komaii, D. melanogaster, D. takahashii.*
72. Sintiku (F) (M. Yamanaka, Nov. 1936) *D. ananassae, D. bipectinata, D. komaii, D. melanogaster, D. montium.*
73. Tainan (F) (U. Ô, Oct. 1934) *D. ananassae.* (U. Ô, Dec. 1934) *D. ananassae, D. melanogaster.* (U. Ô, Oct. 1936) *D. ananassae, D. melanogaster.*
74. Takao (F) (K. Ôta, Nov. 1936) *D. ananassae, D. bipectinata, D. melanogaster.*
75. Saipan (G) (T. Yoshino, Feb. 1937) *D. montium B.* (T. Yoshino, May 1937) *D. montium B.*
76. Palao (Pelew) (G) (F. Hiro, Oct. 1934) *D. ananassae, Apsinota obscuripes.* (K. Hayashi, Oct. 1935) *D. ananassae.* (T. Yamanouti, April 1937) *D. ananassae.*

Looking at the Plate XXIX and the Table 2 one may notice that *Drosophila* is widely distributed and very common in Japan and adjacent localities. There is, however, a definite range in respect to the distribution of each species, and the species so far collected may be divided into the following three categories.

(a) Cosmopolitan species :
> *D. busckii* (Hokkaido, Hondo, Kyûsyû, Korea, Ryûkyû), *D. immigrans* (Hokkaido, Hondo, Sikoku, Kyûsyû, Kwan-tung, Formosa), *D. repleta* (Hondo, Ryûkyû, Formosa).

(b) Arctic and temperate species :
> *D. auraria* (Hondo, Sikoku, Kyûsyû), *D. bizonata* (Hondo), *D. coracina* (Hondo), *D. ficusphila* (Hondo), *D. funebris* (Saghalien, Hokkaido), *D. grandis* (Hondo), *D. histrio* (Hokkaido, Hondo), *D. lutea* (Hondo, Sikoku, Kyûsyû), *D. melanissima* (Hondo), *D. nigromaculata* (Hokkaido, Hondo), *D. nipponica* (Hondo), *D. rufa* (Hondo, Kyûsyû), *D. sordidula* (Hokkaido, Hondo, Korea), *D. subtilis* (Hondo), *D. suzukii* (Hondo, Kyûsyû), *D. transversa* (Hondo, Korea), *D. virilis* (Saghalien, Hokkaido, Hondo, Sikoku, Kyûsyû, Korea).

(c) Tropical species :
> *D. ananassae* (Ogasawara-Is., Ryûkyû, Formosa, Palao), *D. bipectinata*

(Ryûkyû, Formosa), *D. komaii* (Ryûkyû, Formosa), *D. melanogaster* (Hondo, Sikoku, Kyûsyû, Korea, Kwan-tung, Ryûkyû, Formosa), *D. montium* (Hondo, Kyûsyû, Korea, Kwan-tung ?), Ryûkyû, Formosa, Saipan), *D. simulans* (Ogasawara-Is.), *D. takahashii* (Kwan-tung, Formosa).

The above table indicates that there is a sharp boundary of distribution of the group, near the Ryûkyû Islands. Some species such as *D. ananassae*, *D. bipectinata* and *D. komaii* are found in Formosa and Ryûkyû, but not in Kyûsyû and other temperate zones. On the other hand, *D. virilis* is distributed from Saghalien to the southern extremity of Kyûsyû, but has not been collected from Ryûkyû and Formosa. These results remind us of the significance of the so-called Watase's line or Miyake's line. It is of interest that such a boundary is observed in the distribution of the species within the same genus. For the northern regions, however, we have been unable to reach any such definite conclusion.

Another interesting point is the manner of distribution of *Drosophila*. It is generally assumed that *Drosophila* is able to spread far away by their own power of flight. However, recent findings by Komai and Chino seem to indicate a negative conclusion. In order to investigate the problem of chromosomes or gene mutations in wild populations, they have collected many wild flies (*D. melanogaster* and *D. virilis*) from various localities, and bred them individually. The detailed statement of the subject will be published in their own papers, so that only more important points will be given here. (1) Many mutations are found especially in a heterozygous state in wild populations; (2) The same mutant may be found in the strains in different years from the same locality; (3) The same mutant is occasionally found in many strains collected at one time from the same locality. These results suggest strongly that *D. melanogaster* and *D. virilis* are unable to spread very widely by their own power.

Besides, many mutant flies of various species escape from our laboratory, but, in contrary to our expectation, they are rarely captured in the wild of the vicinity. Thus it seems probable that accidental agencies such as typhoon or artificial means of transportation may act more important rôles than their own power of flight upon their spreading.

Mr. K. Hayashi once informed us that *D. ananassae* was very common in a ship plying between Yokohama and Palao. In fact, there is evidence that this species was introduced into Hondo from somewhere else: Professor D. Moriwaki obtained once the species from a vegetable market of Tôkyô in 1931.

(2) Food habits

In spite of the significance of the problem, little is known as to the food-habits of the group. The majority of *Drosophila* larvae are probably primarily

yeast-easters as shown by several investigators (Baumberger 1917 a b, 1919, Loeb and Northrop 1916). But it is also known that some species are parasites on Ceropids and that some are occasionally found in fleshy fungi.

The Japanese species may be roughly classified by their food-habits, as follows:

Fungi: *D. bizonata, D. transversa*

Decaying fruits and sap of bleeding trees:

D. ananassae, D. auraria, D. bipectinata, D. bizonata, D. busckii, D. coracina, D. ficusphila, D. funebris, D. grandis, D. immigrans, D. komaii, D. lutea, D. melanissima, D. melanogaster, D. montium, D. nigromaculata, D. rufa, D. simulans, D. sordidula, D. subtilis, D. suzukii, D. takahashii, D. virilis.

Potatoes, excrement etc: *D. busckii, D. funebris, D. nigromaculata, D. repleta.*

Unknown: *D. histrio* (probably decaying fruits), *D. nipponica.*

Ecological studies concerning Japanese *Drosophila* have been carried out by the following investigators: Kurisaki (1925) (*D. melanogaster*), Kamizawa (1934) (*D. suzukii*), Yagi (1935) (*D. melanogaster*). Yagi states that *D. melanogaster* plays an important rôle as a carrier of Bacteria. This may be true, but judging from their habits, *D. busckii* and *D. repleta* probably take an even more important rôle than *D. melanogaster* in this respect.

V. Description of species

Subgenus *Paradrosophila* Duda 1924

Arch. f. Naturgesch., **90**: 203

(A pair of small prescutellars present)

(1) Drosophila (Paradrosophila) coracina sp. nov.

Imagos: ♂ ♀ Arista with about three branches above and two below. Antennae black. Front about one-third width of head, wider above; black. Second orbital about one-half size of other two. Second oral bristle about one-fourth length of first. Carina narrow and slightly flat; face blackish. A few prominent bristles on each palpus; black. Cheeks black; their greatest width about one-seventh height of eye. Eyes pilose.

Acrostichal hairs in eight rows; a pair of small prescutellars present. Mosonotum, scutellum, pleurae and legs black. Halteres white.

Abdomen black.

Wing clear; vein gray. Costal-index about 1.5; 4V-index about 2.2; 4c-index about 1.5; 5x-index about 2.0 (Pl. XXXI a).

Length body 2.0–2.2 mm; wing 2.0–2.2 mm.

Eggs: About eight filaments (Fig. 1 A). *Third larvae:* Hooklets colorless or tinged. The fully grown larvae can skip. *Pupae:* Posterior spiracles closed (Fig. 3 A). *Chromosomes:* A-type (PL. XXVIII). Testes are shown in Fig. 4 A.

Habitats: Simoda (24), Kyôto (29)

Remarks: Resembles *D. subtilis* ♂ ♀. One generation takes about 25 days at 26°C. Japanese name: *Kurotuya-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

<div align="center">

Subgenus *Spinulophila* Duda 1924

Arch. f. Naturgesch., **90**: 203

(A series of short black spinules on the apical half of
the anteroventral surface of the first femur).

</div>

(2) *Drosophila* (*Spinulophila*) *immigrans* Sturtevant 1921.

D. immigrans: Sturtevant (1921) Carnegie Inst. Wash., **301**: 83–84. Pl. III, 1 ; Fig. 29. (1927) Philippine Journ. Sci., **32**: 367. Peng (1937) Annot. Zool. Japon., **16**: 22–23.

D. tripunctata: Becker (1908) ? Mitt. Zool. Mus. Berlin, **4**: 155. Sturtevant (1918) Bull. Amer. Mus. Nat. His., **38**: 445.

S. tripunctata: Duda (1924) ? Arch. f. Naturgesch , **90**: 210 ; Fig. 71. (1924) Entomologiske Meddelelser, **14**: 262–265 ; Figs. 4, 5, 6, 7.

Imagos: ♂ Arista with about six branches above and three below. Antennae dull-brownish yellow. Front over one-third width of head ; wider above ; dull-brownish yellow. Second orbital one-fourth size of other two. Second oral bristle nearly as long as first. Carina slightly high ; face yellowish brown. A few prominent bristles on each palpus. Cheeks yellow ; their greatest width about one-third height of eye. Eyes with thick pile (Pl. XXX d).

Acrostichal hairs in eight rows : no prescutellars. Mesonotum and scutellum dull-brownish yellow. Pleurae and legs yellow. Sterno-index about 0.75. A row of about ten black bristles on lower apical part of first femur. The first and second joints of prothoracic leg shortened and thickened, with many long blackish hairs on undersurface of those joints (Fig. 5).

Abdomen dull yellow, with a posterior black band on each segment which is broadened and interrupted in mid-dorsal part. The band of last segment broader than others.

Male-hypopygium is

Fig. 5. Prothoracic leg of
D. immigrans ♂. ×ca. 50.
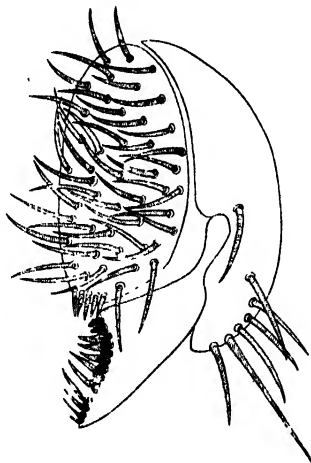
Fig. 6. Hypopygium of
D.immigrans ♂. ×ca. 150.

shown in Fig. 6.

Wing clouded at tips of longitudinal veins, and on posterior crossveins. A single bristle at tip of first costal section (Pl. XXXI b). Costal-index about 4.5; 4V-index about 1.2; 4c-index about 0.5; 5x-index about 1.1.

Length body 3.0 mm; wing 3.0 mm.

♀ Same as above, except that the first and second tarsal joints of prothoracic leg are not shortened and thickened, and that no blackish dense hairs are found on those joints.

Eggs: Four filaments. *Third larvae:* Hooklets blackish. Tip of posterior spiracles black. *Pupae:* Posterior spiracles divergent. *Chromosomes:* D-type (Pl. XXVIII).

Habitats: Tesikaga (4), Sendai (11), Sado (12), Niigata (13), Kamisuwa (16), Kôhu (17), Gotenba (22), Sizuoka (23), Simoda (24), Yaizu (25), Gihu (26), Nagoya (27), Kyôto (29), Tu (31), Kukasyô (32), Asiya (39), Kôbe (40), Tottori (42), Oki (43), Kurasiki (44), Hirosima (45), Matuyama (48), Kôti (49), Ôita (55), Tomioka (57), Port-Arthur (70), Taihoku (71).

Remarks: Resembles *D. tripunctata* ♂ ♀ and *D. histrio* ♂ ♀. *D. immigrans* has been obtained from North America, Europe and China etc. In 1927 Sturtevant reported a variety, *formosana*, from Formosa. The variety differs from typical form only in the front tarsi, namely the short dense hairs of the two basal joints are less conspicuous than in the typical form, but there is a series of much longer recurved black hairs on the outer and anterior surfaces of all the joints of the front tarsi. We examined many specimens of *D. immigrans* collected from Formosa, but failed to find the variety. One generation takes about 12 days at 26°C. Japanese name: *O-Syôzyôbae.*

(3) *Drosophila (Spinulophila) komaii* sp. nov.

Imagos: ♂ (Pl. XXXII) Arista with about six branches above and three below. Antennae reddish yellow; third joint dark-brown. Front over one-third width of head, wider above; reddish yellow, with silvery glitter. Second orbital one-third size of other two. Second oral nearly as long as first. Carina broad, well developed; face reddish yellow. A few prominent bristles on each palpus. Cheeks pale; their greatest width about one-tenth height of eye. Eyes with thick pile (Pl. XXVII).

Acrostichal hairs in eight rows; no prescutellars. Mesonotum and scutellum dull-reddish yellow. Pleurae pale yellow, with a distinct broad reddish-brown stripe which runs from propleura to the base of haltere. Sterno-index about 0.8 (Pl. XXVII). Legs yellow. A row of about ten short stout black bristles on lower apical part of the first femur (Pl. XXVII G).

Abdomen reddish yellow, with a dull-brownish band on each segment. Male-hypopygium is shown in Pl. XXVII F.

Wing slightly dusky, especially near the crossveins. Costal-index about 2.6; 4V-index about 1.8; 4c-index about 0.9; 5x-index about 1.0 (Pl. XXVII H).

Length body 2.5 mm; wing 2.0 mm.

♀ Same as above, except that there is no marked stripe on the pleurae,

and that the silvery glitter on front is indistinct.

Eggs: Four filaments (Fig. 1 F). *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* D-type (Pl. XXVIII).

Habitats: Amami-Ôsima (62), Isigakizima (64), Taihoku (71), Sintiku (72).

Remarks: One generation takes about 12 days at 26°C. Japanese name: *Aka-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

Genus *Drosophila* Fallén 1823

Dipt. Suec. Geomyz., **2**, 4.

(Typical *Drosophila*)

(4) *Drosophila ananassae* Doleschall 1858

D. ananassae: Doleschall (1858) Nat. Tijd. Ned. Ind., **17**, 128: 89. de Meijere (1908) Tijd. v. Entom., **51**: 159. (1911) *Ibid.,* **54**: 399, Fig. 40. Duda (1924) Arch. f. Naturgesch., **90**: 214. (1925) *Ibid,* **91**: 211–213, Figs. 80, 81. (1926) Supplementa Entomologica, **14**: 98. Peng (1937) Annot. Zool. Japon., **16**: 26–27.

D. caribbea: Sturtevant (1916) Ann. Ent. Soc. Amer., **9**: 335. (1921) Carnegie Inst. Wash., **301**: 92–93, Fig. 25.

D. errans: Malloch (1934)? British Mus. (Nat. Hist.) Part **6**: 301.

D. imparata: Walker (1859) Proc. Linn. Soc., **3**: 126; 164.

D. similis: Lamb (1914)? Trans. Linn. Soc., **3**: 16: 347.

Imagos: ♂ Arista with about five branches above and three below. Antennae yellow; third joint brown. Front nearly one-half width of head, wider above; yellow. Second orbital about one-half size of other two. Second oral bristle, nearly as long as first, but usually smaller than first. Carina broad and flat; face pale yellow. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-sixth height of eye. Eyes with thick pile.

Acrostichal hairs somewhat irregular, but generally in eight rows; no prescutellars. Mesonotum and scutellum reddish yellow, slightly shining. Pleurae and legs yellow. Sterno-index
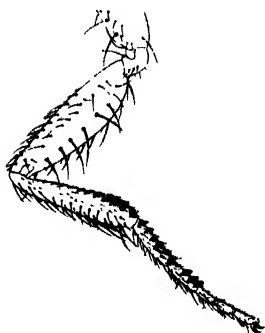
Fig. 7. Prothoracic leg of *D. ananassae* ♂. ×ca. 60.

Fig. 8. Hypopygium of *D. ananassae* ♂. ×ca. 150.

about 0.5. Several transverse rows of stout blackish bristles on the ventral surface of the first and second tarsal joints of prothoracic leg. These bristles become yellowish in color as they approach the base of each joint (Fig. 7).

Abdomen yellow; each segment with a dull brown posterior band. Hypo-pygium is shown in Fig. 8.

Wing clear; Costal-index about 1.2; 4V-index about 2.3; 4c-index about 2.0; 5x-index about 2.0 (Pl. XXXI e).

Length body 2.0–2.3 mm; wing 2.0–2.3 mm.

♀ Differs from the male in having no blackish bristles on the tarsal joints of prothoracic leg.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* L-type (Pl. XXVIII).

Habitats: Tôkyô (18), Hahazima (20), Naka-Iwôtô (21), Amami-Ôsima (62), Isigakizima (64), Taihoku (71), Sintiku (72), Tainan (73), Takao (74), Palao (76).

Remarks: Resembles *D. bipectinata* ♀. According to the previous investigators, *D. ananassae* is widely distributed and very common in tropical regions (North America, Central America, South America, Java, Sumatra, New Guinea, Philippines, China etc). The genetics and cytology of this species have been reported by several investigators (Kaufmann, Kikkawa, Moriwaki, Sturtevant). One generation takes about 10 days at 26°C. Japanese name: *Ananasu-Syôzyôbae.*

(5) *Drosophila bipectinata* Duda 1923

> *D. bipectinata:* Duda (1923) Ann. Musei Nationalis Hungarici, 20: 52–53. (1924) Arch. f. Naturgesch., 90: 214. (1926) Supplementa Entomologica, 14: 98–99, Fig. 16.

Imagos: ♂ Arista with about four branches above and three below. Antennae yellow; third joint brown. Front over one-third width of head, wider above; yellow. Second orbital about one-third size of other two. Second oral nearly as long as first, but usually smaller than first. Carina broad, slightly high; face pale. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-eighth height of eye. Eyes with thick pile.

Acrostichal hairs somewhat irregular, but generally in eight rows; no prescutellars. Mesonotum and scutellum yellow, slightly shining. Pleurae and legs yellow. Sterno-index about 0.5. Two oblique combs of

Fig. 9. Prothoracic leg of *D. bipectinata* ♂. ×ca. 50.

Fig. 10. Hypopygium of *D. bipectinata* ♂. ×ca. 150.

black stout bristles, on the inner surface of first tarsal joint of prothoracic leg. A few stout black bristles, on the distal part of second tarsal joint of the same leg (Fig. 9).

Abdomen yellow; each segment with a dull brown posterior band. Hypopygium is shown in Fig. 10.

Wing clear; Costal-index about 1.2; 4V-index about 2.2; 4c-index about 1.8; 5x-index about 2.0.

Length body 1.5–2.0 mm; wing 1.5–2.0 mm.

♀ Agrees with the above description, except that there is no tarsal comb.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* L-type (Pl. XXVIII).

Habitats: Isigakizima (64), Taihoku (71), Sintiku (72), Takao (74).

Remarks: Resembles *D. ananassae* ♀. Duda (1924) collected this species from East Indies. One generation takes about 10 days at 26°C. Japanese name: *Hime-Syôzyôbae (Hutakusi-Syôzyôbae).*

(6) *Drosophila auraria* Peng 1937

D. auraria: Peng (1937) Annot. Zool. Japon., **16**: 23–24.

Imagos: ♂ Arista with about five branches above and three below. Antennae brown. Front over one-third width of head, wider above; yellow. Second orbital bristle about one-third size of other two. Second oral nearly as long as first. Carina narrow, slightly flat; face snowy white. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-sixth height of eye. Eyes with rather thick pile.

Acrostichal hairs in six rows; no prescutellars. Mesonotum, scutellum and pleurae shining yellow. Sterno-index about 0.5. Legs yellow. A comb of about 26 stout black bristles on the inner surface of the first tarsal joint of prothoracic leg. A similar comb of about 18 black bristles on the same surface of the second tarsal joint of prothoracic leg.

Abdomen shining yellow, with a blackish posterior band on each segment (the sixth segment black). Hypopygium is shown in Fig. 11.

Wing clear; Costal-index about 2.0; 4V-index about 2.7; 4c-index about 1.5; 5x-index about 2.0 (Pl. XXXI g).

Length body 2.0 mm; wing 2.0 mm.

♀ Differs from the male in having no tarsal combs, and that the face-color is pale instead of white as in the male.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* A-type (Pl. XXVIII). Testes are shown in Fig. 4 D.

Habitats: Akita (9), Sendai (11), Niigata (13), Kamisuwa (16), Kôhu (17), Gotenba (22),

Fig. 11. Hypopygium of *D. auraria* ♂. ×ca. 150.

Nagoya (27), Ayabe (28),. Kyôto (29), Kukasyô (32), Sizyônawate (34), Kôbe (40), Himezi (41), Kurasiki (44), Matuyama (48), Kôti (49), Miyazaki (58).

Remarks: Resembles *D. montium* ♂ ♀, *D. nipponica* ♂ ♀, *D. rufa* ♂ ♀ and *D. ficusphila* ♂ ♀. One generation takes about 14 days at 25°C. Japanese name: *Kaoziro-Syôzyôbae.*

(7) *Drosophila rufa* sp. nov.

Imagos: ♂ Arista with about five branches above and three below. Antennae brown; third joint dark brown. Front less than one-third width of head, wider above. brownish yellow. Second orbital bristle about one-fourth size of other two. Second oral about two-thirds length of first. Carina narrow and flat; face brownish yellow. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-eighth height of eye. Eyes with fine pile.

Acrostichal hairs vary from six to eight in a row, but generally eight rows; no prescutellars. Mesonotum reddish yellow, shining. Scutellum brownish yellow, shining. Pleurae yellow. with a broad dark-brownish longitudinal stripe on each side. Sterno-index about 0.6. A comb of about 25 stout black bristles on the inner surface of the first tarsal joint of prothoracic leg. A similar comb of about 18 black bristles on the same surface of the second tarsal joint of prothoracic leg (Fig. 12).

Fig. 12. Prothoracic leg of *D. rufa* ♂. ×ca. 60.

Abdomen shining yellow, with a black posterior band on each segment (2–5), but 5–6 segments almost black. Hypopygium is shown in Fig. 13.

Wing clear. Costal-index about 2.3; 4V-index about 2.5; 4c-index about 1.3; 5x-index about 3.0.

Length body 2.0–2.2 mm; wing 2.0–2.2 mm. ♀ Differs from the male in having no tarsal combs and in that clypeus is brown in color instead of black as in the male.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Kôhu (17), Kyôto (29), Asiya (39), Ôita (55).

Remarks: Resembles *D. auraria* ♂ ♀, *D. ficusphila* ♂ ♀, *D. montium* ♂ ♀ and *D. nipponica* ♂ ♀. One generation takes about 12 days at 26°C. Japanese name:

Fig. 13. Hypopygium of *D. rufa* ♂. ×ca. 150.

Munasuzi-Syôzyôbae. Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(8) *Drosophila montium* de Meijere 1916

> *D. montium*: de Meijere (1916) Tijd. v. Entom., **59**: 205–206. Duda (1924) Arch. f. Naturgesch., **90**: 215. (1926) Supplementa Entomologica, **14**: 99, Fig. 17. Malloch (1934) British Mus. (Nat. Hist.) Part 6: 300–301.

Imagos: Race *A* ♂ Arista with about five branches above and three below. Antennae brown; third joint dark-brown. Front more than one-third width of head, wider above; yellow. Second orbital bristle about one-third size of other two. Second oral nearly as long as first. Carina narrow and flat; face pale. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-seventh height of eye. Eyes with rather thick pile.

Acrostichal hairs in six rows; no prescutellars. Mesonotum, scutellum and pleurae shining yellow. Sterno-index about 0.6. Legs yellow. A comb of about 25 stout black bristles on the inner surface of the first tarsal joint of prothoracic leg. A similar comb of about 18 black bristles on the same surface of the second tarsal joint of prothoracic leg.

Fig. 14. Hypopygium of *D. montium* ♂. ×ca. 150.

Abdomen shining yellow, with a blackish posterior band on each segment, but the band becomes yellowish in color on the fifth and the sixth segment. Hypopygium is shown in Fig. 14.

Wing clear. Costal-index about 2.1; 4V-index about 2.5; 4c-index about 1.5; 5x-index about 2.5.

Legth body 2.0 mm; wing 2.0 mm.

♀ Differs from the male in having no tarsal combs on the tarsal joints of prothoracic leg.

Eggs: Two filaments (Fig. 1 D). *Third larvae*: Hooklets blackish. *Pupae*: Posterior spiracles divergent. *Chromosomes*: M-type (Pl. XXVIII).

Habitats: Tokuyama? (46), Hukuoka (50), Kawatana? (53), Ôita (55), Tomioka (57), Miyanozyô? (59), Amami-Ôsima (62), Naha (63), Isigakizima (64), Keizyô? (69), Port-Arthur? (70), Taihoku (71), Sintiku (72).

Race B: ♂ ♀ *Imagos, eggs, third larvae, pupae*: Agrees entirely with the above, except the cytological difference. *Chromosomes*: N-type (Pl. XXVIII).

Habitats: Simoda (24), Yuasa (36), Matuyama (48), Saipan (75).

Remarks: Resembles *D. auraria* ♂ ♀, *D. ficusphila* ♂ ♀, *D. nipponica* ♂ ♀ and *D. rufa* ♂ ♀. In 1924, Duda described two varieties of *D. montium*, *xanthopyga* and *atropyga*, from Java and Formosa respectively. The former is distinguished from the latter by the fact that the last abdominal

segment is yellow in color instead of black as in the latter. The specimens thus far examined by us all belong to *xanthopyga*. But, as shown before, it is possible to classify two races from a cytological view-point (Kikkawa 1936). The records of capture suggest that this species is very common in the Oriental Region. One generation takes about 12 days at 27°C. Japanese name: *Torahu-Syôzyôbae*.

(9) *Drosophila nipponica sp. nov.*

Imagos: ♂ Arista with about five branches above and two below. Antennae brown; third joint dark-brown, with long hairs. Front over one-half width of head, wider above; yellow. Second orbital bristle very fine, about one-fifth size of other two. Second oral about one-half length of first. Carina broad and flat; face yellow. A few prominent bristles on each palpus. Cheeks yellow; their greatest width about one-fourth height of eye. Eyes with rather thick pile (Fig. 15).

Acrostichal hairs in six rows; no prescutellars. Mesonotum and scutellum yellow. Pleurae and legs yellow; sterno-index about 0.3. A comb of about 15 stout black bristles on the inner surface of the first tarsal joint of prothoracic leg. A similar comb of about 13 black bristles on the same surface of the second tarsal joint of prothoracic leg.

Abdomen yellow, with a dark brownish posterior band on each segment, but the band becomes yellowish in color on the fifth and the sixth segment.

Fig. 15. Head of *D. nipponica* ♂. ×ca. 45.

Wing clear. Costal-index about 2.0; 4V-index about 2.2; 4c-index about 1.1; 5x-index about 1.6.

Length body 1.8 mm; wing 1.8 mm.

♀ Differs from the male in having no tarsal combs.

Eggs, third larvae, pupae and *chromosomes* are unknown.

Habitats: Ayabe (26).

Remarks: Resembles *D. auraria* ♂ ♀, *D. ficusphila* ♂ ♀, *D. montium* ♂ ♀ and *D. rufa* ♂ ♀. Kikkawa obtained this species on leaves of clover (*Sagina maxima* A. Gray), but failed to breed on a culture-medium containing decaying fruits. Japanese name: *Yamato-Syôzyôbae*. Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(10) *Drosophila ficusphila sp. nov.*

Imagos: ♂ Arista with about four branches above and two below. Antennae yellow; third joint brown. Front less than one-third width of head, wider above; yellow. Second orbital bristle about one-third size of other two. Second oral about three-fourth length of first. Orbital, ocellar and vertical bristles well developed. Carina narrow, flat; face yellow. Only one prominent

bristle on each palpus. Cheeks yellow; their greatest width about one-seventh height of eye. Eyes with rather thick pile.

Acrostichal hairs in eight rows; no prescutellars. Mesonotum reddish yellow, but brownish yellow near the base of wing. Scutellum and pleurae brownish yellow. Sterno-index about 0.8. A comb of about 25 stout black bristles on the inner surface of the first tarsal joint of prothoracic leg. A similar comb of about 18 black bristles on the same surface of second tarsal joint of prothoracic leg, which overlaps the third joint. Furthermore, several stout black bristles on each comb described above (Fig. 16).

Abdomen shining black, with a broad yellowish band on the anterior part of each segment from the first to the fourth.

Wing clear. Costal-index about 1.8; 4V-index about 2.0; 4c-index about 1.2; 5x-index about 1.5 (Pl. XXXI q). Length body 2.2 mm; wing 2.0 mm.

Fig. 16. Prothoracic leg of *D. ficusphila* ♂. ×ca. 180.

♀ Differs from the male only in having no tarsal combs.

Eggs: Two filaments. *Third larvae:* Hooklets some-what blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Kôhu (17), Kyôto (29), Katuura (38).

Remarks: Resembles *D. auraria* ♂ ♀, *D. montium* ♂ ♀, *D. nipponica* ♂ ♀ and *D. rufa* ♂ ♀. This species has a special fondness for the fruits belonging to the genus *Ficus* such as *F. Carica* and *F. erecta*. One generation takes about 14 days at 26°C. Japanese name: *Itiziku-Syôzyôbae*. Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(11) *Drosophila bizonata* sp. nov.

Imagos: ♂ ♀ Arista with about five branches above and three below. Antennae brownish yellow; third joint brown. Front about one-third width of head, wider above; yellow. Second orbital bristle very fine, about one-fifth size of other two. Second oral nearly as long as first. A few prominent bristles on each palpus. Carina narrow, slightly high; face yellow. Cheeks yellow; their greatest width about one-fifth height of eye. Eyes with rather thick pile.

Acrostichal hairs in six rows; no prescutellars. Mesonotum and scutellum shining yellow. Pleurae yellow; sterno-index about 0.6. Legs pale yellow.

Abdomen shining yellow, with a brownish band on the posterior part of each segment, which is interrupted in mid-dorsal part. The bands of two basal segments (occasionally three) are darker and broader than those of other segments.

Wing clear. Costal-index about 3.0; 4V-index about 1.5; 4c-index about 0.8; 5x-index about 1.2. Tips of II, III, IV longitudinal veins and the parts

near the crossveins are slightly clouded (Pl. XXXI f).

Length body 2.0 mm; wing 2.0–2.2 mm.

Eggs: Four filaments. *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* H-type (Pl. XXVIII).

Habitats: Kyôto (29), Kôbe (40)

Remarks: One generation takes about 12 days at 26°C. Japanese name: *Hutaobi-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(12) *Drosophila lutea* sp. nov.

Imagos: ♂ Arista with about five branches above and three below. Antennae brown. Front over one-third width of head, wider above; yellow. Second orbital bristle about one-third size of other two. Second oral about two-thirds length of first. Carina narrow and flat; face yellow. Only one prominent bristle on each palpus. Cheeks yellow; their greatest width about one-tenth height of eye. Eyes pilose.

Acrostichal hairs in eight rows; no prescutellars. Mesonotum and scutellum reddish yellow, slightly shining. Pleurae yellow. Sterno-index about 0.7. Legs yellow. On the undersurface of the first tarsal joint of prothoracic leg, there are two transverse rows of about three short stout black bristles respectively. Two such rows of a few black bristles respectively on the same surface of the second tarsal joint of prothoracic leg (Fig. 17).

Abdomen shining black; each of the four basal segments with a basal broad yellowish band. Hypopygium is shown in Fig. 18.

Fig. 17. Prothoracic leg of *D. lutea* ♂. ×ca. 50.

Wing slightly brownish in color. Costal-index about 2.0; 4V-index about 2.2; 4c-index about 1.2; 5x-index about 2.0.

Length body 2.0–2.3 mm; wing 2.0–2.3 mm.

♀ Agrees with the above description, except that the front tarsi are plain, and that each abdominal segment has a basal broad yellowish band.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Innai (10), Sendai (11), Sado (12), Niigata (13), Kanazawa (14), Nagano (15), Kamisuwa (16), Kôhu (17), Gotenba (22), Sizuoka (23), Simoda (24), Yaizu (25), Gihu (26), Ayabe (28), Kyôto (29), Asiya (39), Kôbe (40), Oki (43), Matuyama (48). Kôti (49), Ôita (55), Miyazaki (58).

Remarks: Resembles *D. melanogaster* ♀, *D.*

Fig. 18. Hypopygium of *D. lutea* ♂. ×ca. 150.

suzukii ♀ and especially *D. takahashii* ♂ ♀. One generation takes about 10 days at 26°C. Japanese name: *Kihada-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(13) *Drosophila takahashii* Sturtevant 1927

> *D. takahashii:* Sturtevant (1927) Philippine Journ. Sci., **32**: 371. Peng (1937) Annot. Zool. Japon., **16**: 27.
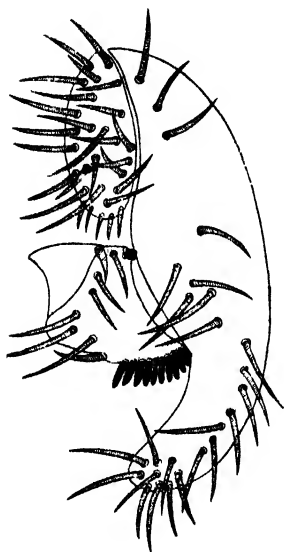
Fig. 19. Hypopygium of *D. takahashii* ♂. ×ca. 160.

Imagos: ♂ ♀ Agrees entirely with the descriptions of *D. lutea*, except that: (1) *D. takahashii* is smaller in size than *D. lutea*, (1.8 mm); (2) *D. lutea* has a small blackish spot in the groove located at the base of coxa of prothoracic leg; but such a spot is absent in *D. takahashii;* (3) *D. takahashii* seems to be a tropical or subtropical species, but *D. lutea* is a temperate or arctic species. *References:* Fig. 19 (Male-hypopygium); Pl. XXXI o (wing).

Eggs: (Fig. 1 B), *larvae, pupae* and *chromosomes* accord entirely with those of D. *lutea.*

Habitats: Port-Arthur (70), Taihoku (71).

Remarks: Resembles *D. melanogaster* ♀, *D. suzukii* ♀ and especially *D. lutea* ♂ ♀. One generation takes about 10 days at 26°C. Japanese name: *Takahasi-Syôzyôbae.*

(14) *Drosophila melanogaster* Meigen 1830

> *D. melanogaster:* Meigen (1830) Syst. Beschr., **6**: 85. Sturtevant (1921) Carnegie Inst. Wash., **301**: 89–91, Figs. 2, 8, 11, 13, 31, 45; PL. III 2. Kurisaki (1925) Represajo de la Bulteno Scienca de la Fakultato Terkultura, **1**: 274–284. Esaki (1932) Nippon Konchû Zukan: 28, Fig. 47. Strasburger (1935) Berlin Verlag v. Julius Springer: 1–60. Peng (1937) Annot. Zool. Japon., **16**: 25–27.

> *D. ampelophila:* Loew (1862) Berlin Ent. Zeit., **6**: 231. Duda (1924) Arch. f. Naturgesch., **90**: 214, Fig. 82. (1924) Entomologiske Meddelelser, **14**: 280–285, Figs. 17, 18, 19. (1925) Arch. f. Naturgesch., **91**: 147. Malloch (1934) British Mus. (Nat. Hist.) Part **6**: 300.

Described species assumed to be synonymous with *D. melanogaster. D. fasciata* Meigen (1830), *D. nigriventris* Zetterstedt (1847), *D. melanogaster* Schiner (1864), *D. uvarum* Rondani (1875), *D. pilosula* Becker (1908).

Imagos: ♂ Arista with about five branches above and three below. Antennae yellow. Front nearly one-half width of head, wider above; yellow. Second orbital bristle one-third size of other two. Second oral nearly as long as first. Carina broad and flat; face yellow. A few prominent bristles on each palpus. Cheeks yellow; their greatest width about one-fourth height of

eye. Eyes with rather thick pile.

Acrostichal hairs in eight rows; no prescutellars. Mesonotum and scutellum reddish yellow, shining. Pleurae and legs pale yellow. Sterno-index about 0.5. A comb of about 10 stout black bristles on the inner distal surface of the first tarsal joint of prothoracic leg in oblique direction (Fig. 20).
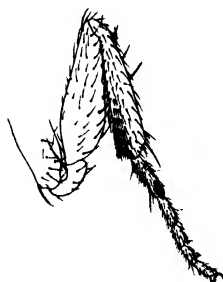
Fig. 20. Prothoracic leg of D. melanogaster ♂. ×ca. 60.
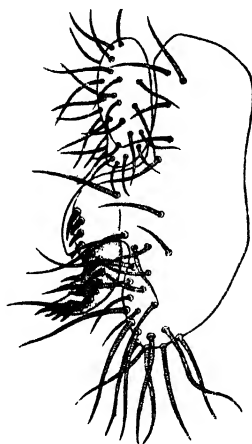
Fig. 21. Hypopygium of D. melanogaster ♂. ×ca. 150.
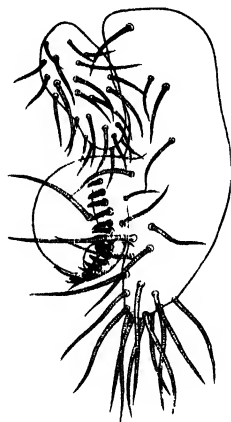
Fig. 22. Hypopygium of D. simulans ♂. ×ca. 150.

Abdomen shining black, with a basal reddish yellow band on each of the basal four segments. Hypopygium is shown in Fig. 21.

Wing clear. Costal-index about 2.2; 4V-index about 2.4; 4c-index about 1.5; 5x-index about 2.1 (Pl. XXXI n).

Length body 2.0–2.2 mm; wing 2.0–2.2 mm.

♀ Differs from the male in having no tarsal comb and in having a basal reddish-yellow band also on the fifth and sixth abdominal segment.

Eggs: Two filaments (Fig. 1 C). *Third larvae:* Hooklets blackish (Pl. XXX a b, Fig. 2). *Pupae:* Posterior spiracles divergent (Fig. 3 B). *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Kamisuwa (16), Kôhu (17), Titizima (19), Hahazima (20), Naka-Iwôtô (21), Gotenba (22), Sizuoka (23), Simoda (24), Kyôto (29), Nara (35), Yuasa (36), Seto (37), Katuura (38), Kôbe (40), Himezi (41), Hirosima (45), Kwannonzi (47), Hukuoka (50), Yanagawa (51), Kawatana (53), Waihu (54), Kumamoto (56), Tomioka (57), Miyazaki (58), Kagosima (60), Sibusi (61), Amami-Ôsima (62), Naha (63), Isigakizima (64), Kyôzyô (65), Syuotu (66), Syunsen (68), Keizyô (69), Port-Arthur (70), Taihoku (71), Sintiku (72), Takao (74).

Remarks: Resembles *D. lutea* ♀, *D. suzukii* ♀, *D. takahashii* ♀ and especially *D. simulans* ♂ ♀. *D. melanogaster* is widely distributed and very common all over the world. It is well known that this species is used under

this name as a favourable material for genetical, cytological and other biological studies. However, most taxonomists argue that the name *D. ampelophila* is to be used for this species. In order to avoid confusion, we may adopt the name *D. melanogaster* in this paper. One generation takes about 10 days at 26°C. Japanese name: *Nami-Syôzyôbae*, (*Syôzyôbae, Kiiro-Syôzyôbae*).

(15) *Drosophila simulans* Sturtevant 1919

 D. simulans: Sturtevant (1919) Psyche 26: 153. (1921) Carnegie Inst. Wash., **301**: 91, Figs. 5, 15, 46; Pl. I 5.

 Imagos: ♂ ♀ No constant differences from *D. melanogaster*, except that: the eye is larger than that of *melanogaster*, and that the shape of clasper and of the posterior process of the hypopygium of male, are distinct (Fig. 22).

 Eggs, third larvae, pupae and *chromosomes*: Nearly same as of *D. melanogaster*.

 Habitats: Titizima (19), Hahazima (20).

 Remarks: Resembles *D. lutea* ♀, *D. suzukii* ♀, *D. takahashii* ♀ and especially *D. melanogaster* ♂ ♀. *D. simulans* was first collected from the Eastern States of North America, but recently it is known that this species is distributed not only in North America, but also in Europe, Australia and now in Asia. Japanese name: *Onazi-Syôzyôbae*.

(16) *Drosophila suzukii* (Matsumura) Kamizawa 1931

 Leucophenga suzukii: Matsumura (1931) Illustrated Insects of Japan Empire: 366, Fig. 158.

 D. suzukii Kamizawa (1934) Report of Yamanasi Agricul. Exp. Station, 1: 1–24, 2 Pls. Peng (1937) Annot. Zool. Japan., **16**: 21–22.

 Imagos: ♂ (Pl. XXXII) Arista with about five branches above and three below. Antennae yellow; third joint yellowish brown. Front about one-third width of head, wider above; yellow. Second orbital bristle about one-half size of other two, and situated nearly in the middle between the other two, Second oral nearly as long as first. Only one prominent bristle on each palpus. Carina narrow and high; face yellow. Cheeks pale yellow; their greatest width about one-sixth height of eye. Eyes with rather thick pile.

Acrostichal hairs in eight rows; no prescutellars. Mesonotum, scutellum and pleurae yellow, slightly shining. Sterno-index about 0.7. Legs yellow. A comb of about four black short stout bristles on the inner distal surface of the first tarsal joint of prothoracic leg. A similar comb of a few black bristles on the same surface of the second tarsal joint of prothoracic leg (Fig. 23).

Abdomen shining black, with a broad yellowish basal band on each of the basal four segments.

Wing hyaline. A blackish spot at tip of the second longitudinal vein. Costal-index about 4.0; 4V-index about 2.2; 4c-index about 0.8; 5x-index about 1.6 (Pl. XXXI l).

Fig. 23. Prothoracic leg of *D. suzukii* ♂. ×ca. 50.

Length body 2.0–2.2 mm ; wing 2.0–2.2 mm.

♀ Differs from the male in having no tarsal combs and in that each segment has a basal yellowish band, and also in that the blackish spot in wing is very indistinct. The egg-guides well developed upward.

Eggs: Two filaments. *Third larvae:* Hooklets blackish. *Pupae:* Posterior spiracles divergent. *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Kôhu (17), Gotenba (22), Kyôto (29), Ôita (55).

Remarks: Resembles *D. lutea* ♀, *D. melanogaster* ♀, *D. simulans* ♀ and *D. takahashii* ♀. Kamizawa (1934) published an extensive paper concerning the ecological study of this species. Peng obtained this species from Sanhu of China in 1935. One generation takes about 12 days at 26°C. Japanese name : *Ôtô-Syôzyôbae* (*Tumaguro-Syôzyôbae*).

(17) *Drosophila nigromaculata* sp. nov.

Imagos: ♂ ♀ Arista with about five branches above and three below. Antennae brownish yellow. Front about one-half width of head, wider above ; brownish yellow. Second orbital bristle about one-fourth size of other two. Second oral about three-fourths length of first. Carina broad and high ; face yellow. Only one prominent bristle on each palous. Cheeks yellow ; their greatest width about one-fourth height of eye. Eyes with rather thick pile.

Acrostichal hairs in six rows ; no prescutellars. Mesonotum and scutellum brownish yellow, shining. Pleurae yellow, sterno-index about 0.7. Legs yellow. Many long hairs which stand erect on the tarsal joints of prothoracic leg.

Abdomen shining yellow, with four triangular black spots on each segment from the second to the fifth. Only two spots on the sixth segment. There is also a blackish spot on the lateral margin of each dorso-lateral plate, except the last segment.

Wing yellowish in color. Tip of the third longitudinal vein and parts of crossveins are clouded ; dark brown. Costal-index about 3.2 ; 4V-index about 1.4 ; 4c-index about 0.7 ; 5x-index about 0.9 (Pl. XXXI d).

Length body 3.0 mm ; wing 3.0 mm.

Eggs, larvae: Unknown, but judging from the structure of pupae, hooklets of the larvae should be colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* Unknown.

Habitats: Sapporo (7), Ayabe (28), Kyôto (29).

Remarks: Somewhat resembles *D. transversa* ♂ ♀. Japanese name : *Ô-hosi-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(18) *Drosophila transversa* Fallén 1823

D. transversa: Fallén (1823) Diot. Suec. Geomyz., 2 : 6. Sturtevant (1921) Carnegie Inst. Wash., 301 : 81, Fig. 40 ; Pl. I 7. Duda (1924) Entomologiske Meddelelser, 14 : 291–293, Fig. 24. (1924) Arch. f. Naturgesch., 90 : 218, Fig. 89.

Imagos: ♂ ♀ Arista with about five branches above and three below. Antennae yellowish brown. Front about one-half width of head, wider above ;

reddish yellow. Second orbital bristle very fine, about one-fifth size of other two. Second oral one-half length of first; other oral bristles very fine and short. Carina broad and flat; face yellow. A few prominent bristles on each palpus. Cheeks yellow; their greatest width about one-third height of eye. Eyes with rather fine pile.

Acrostichal hairs in six rows; no prescutellars. Mesonotum and scutellum reddish yellow, shining. Pleurae and legs yellow. Sterno-index about 0.6. Many long hairs which stand erect on the tarsal joints of prothoracic leg (Fig. 24).

Abdomen shining yellow, with four black triangular spots on each segment from the second to the fifth, but the number of these spots varies from two to four on the fourth and fifth segments.

Wing clouded at the tip of III and IV longitudinal veins and on each crossvein. Costal-index about 3.0; 4V-index about 1.5; 4c-index about 0.9; 5x-index about 1.2.

Fig. 24 Prothoracic leg of *D. transversa* ♂. ×ca. 50.

Length body 2.2–2.5 mm; wing 2.2–2.5 mm.

Eggs: Three filaments; median one is thicker than the others (Fig. 1 E). *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* F-type (Pl. XXVIII).

Habitats: Kôhu (17), Gotenba (22), Kyôto (29), Kôbe (40), Keizyô (69).

Remarks: Resembles *D. nigromaculata* ♂ ♀. In respect to the structure of imago alone, the specimens examined resemble rather *D. quinaria* Loew than *D. transversa* Fallén. But the structures of eggs and of chromosome types indicate that the species differs clearly from *D. quinaria*. Therefore, the name *D. transversa* is used here, but we have no conviction as to this identification. One generation takes about 12 days at 26°C. Japanese name: *Hosi-Syôzyôbae*.

(19) *Drosophila melanissima* Sturtevant 1916

D. melanissima: Sturtevant (1916) Ann. Ent. Soc. Amer., **9**: 333. (1921) Carnegie Inst. Wash., **301**: 95.

Imagos: ♂ Arista with about four branches above and two below. Antennae black brown. Front about one-third width of head, wider above; blackish. Second orbital bristle about one-third size of other two. The ratio of the second oral bristle to the first irregular, but usually less than 1.0. Carina broad and flat; face black. A few prominent bristles on each palpus. Cheeks dark brown; their greatest width about one-fourth height of eye. Eyes with short thick black pile.

Acrostichal hairs in six rows; no prescutellars. Mesonotum, scutellum and pleurae blackish brown. Sterno-index about 0.9. Legs brown.

Abdomen black with a narrow brownish anterior band on each segment. Wing slightly brownish. Costal-index about 2.2; 4V-index about 2.0; 4c-

index about 1.1; 5x-index about 1.0 (Pl. XXXI j).

Length body 2.3 mm; wing 2.3 mm.

♀ Agrees with the above description except that the basal bands of abdominal segments are broader and more yellowish in color. These bands project into the posterior region in the middle and lateral parts, especially in old females.

Eggs: Two filaments. *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles closed. *Chromosomes:* E-type (Pl. XXXVIII).

Habitats: Kyôto (29), Kôbe (40).

Remarks: Examining the species, it was found that this species resembles very closely both *D. melanica* Sturtevant and *D. melanissima* Sturtevant. But, as the result of crossing with *D. melanica* which was sent by Prof. W. P. Spencer from the North America, it was proved that they were not identical species. Therefore, the name *D. melanissima* is used here, but we have no conviction as to this identification. One generation takes about 12 days at 26°C. Japanese name: *Karasu-Syôzyôbae.*

(20) Drosophila sordidula *sp. nov.*

Imagos: ☿ ♀ Arista with about five branches above and two below. Antennae black. Front about two-fifths width of head, wider above; dark brown. Second orbital bristle about one-third size of other two. Only one prominent oral bristle. Carina broad and flat; face brown. A few prominent bristles on each palpus. Cheeks brown; their greatest width about one-fifth height of eye. Eyes pilose.

Acrostichal hairs irregular in row, varying from six to eight; no prescutellars. Mesonotum dull blackish brown, with four indistinct brownish stripes on the anterior parts. Scutellum and pleurae blackish-brown. Sterno-index about 0.7. Legs brown.

Abdomen brown, with a broad blackish band on each segment. Hypopygium is shown in Fig. 25.

Wing somewhat dusky. Costal-index about 3.2; 4V-index about 1.8; 4c-index about 0.7; 5x-index about 1.0 (Pl. XXXI h).

Length body 3.0 mm; wing 3.0 mm.

Eggs: Four filaments. *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* E-type (Pl. XXVIII).

Habitats: Sapporo (7), Akita (9), Innai (10), Sado (12), Kamisuwa (16), Gotenba (22), Kyôto (29), Keizyô (69).

Remarks: D. sordidula resembles closely *D. sulcata* Sturtevant ☿ ♀. But, by crossing method, it was found that they were not identical species. One generation takes about 16 days
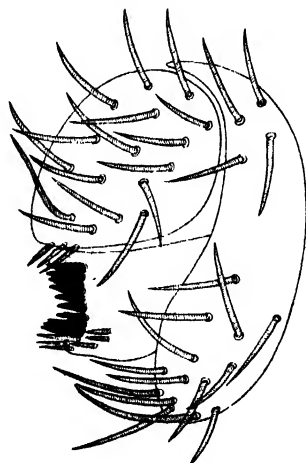
Fig. 25. Hypopygium of *D. sordidula* ☿. ×ca. 150.

at 26°C.   Japanese name : *Ô-Kuro-Syôzyôbae*.   Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(21) *Drosophila virilis* Sturtevant 1916

D. virilis: Sturtevant (1916) Ann. Ent. Soc. Amer., **9**: 330. (1921) Carnegie Inst. Wash., **301**: 97, Figs. 12, 42, 48.   Esaki (1932) Nippon Konchû Zukan : 28, Fig. 48. Peng (1937) Annot. Zool. Japon., **16**: 22–23.

D. nigrifemur: Duda (1926) Arch. f. Naturgesch., **91**: 192–193.

Imagos: � (Pl. XXXII) ♀ Arista with about five branches above and two below. Antennae brown ; third joint dark-brown. Front over one-third width of head, wider above ; brown. Second orbital bristle one-third size of other two. Second oral one-half length of first. Only one prominent bristle on each palpus. Carina broad and high ; face brown, slightly shining. Cheeks yellowish brown ; their greatest width about one-third height of eye. Eyes pilose.

Acrostichal hairs in six rows ; no prescutellars. Mesonotum dull brown with four indistinct dark-brown longitudinal stripes. Scutellum, pleurae dark dull brown. Sterno-index about 0.9. Legs pale brown. In male, there are many long brownish hairs which stand erect on the tarsal joints of prothoracic leg.

Abdomen dark brown. Hypopygium is shown in Fig. 26.

Wing clear. Costal-index about 2.5 ; 4V-index about 1.8 ; 4c-index about 1.0 ; 5x-index about 1.0 (Pl. XXXI k).

Fig. 26. Hypopygium of *D. virilis*
☿. ×ca. 150.

Length body 2.5–3.0 mm ; wing 2.5–3.0 mm.

Eggs: Four filaments. *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* F-type (Pl. XXVIII).

Habitats: Ôtomari (1), Rebun-Tô (2), Risiri-Tô (3), Tesikaga (4), Akkesi (5), Kamikawa (6), Sapporo (7), Hirosaki (8), Akita (9), Innai (10), Niigata (13), Kanazawa (14), Kamisuwa (16), Kôhu (17), Tôkyô (18), Gotenba (22), Gihu (26), Ayabe (28), Kyôto (29), Kitazato (30), Tu (31), Kukasyô (32), Sizyônawate (34), Kôbe (40), Himezi (41), Tottori (42), Hirosima (45), Tokuyama (46), Matuyama (48), Kôti (49), Hukuoka (50), Yanagawa (51), Saga (52), Waihu (54), Miyazaki (58), Miyanozyô (59), Kagosima (60), Kankô (67), Syunsen (68), Keizyô (69).

Remarks: This species is widely distributed and common in the eastern Palaearctic regions, but very rare in the Nearctic regions. As pointed out by Sturtevant (1921), the occurrence of *D. virilis* in North America may be due to importation. Though no extensive study has yet been performed, the Japanese form is somewhat different from the American ; namely, the former is longer than the latter in both the length of body and of wing. The

genetics of this species has been carried out largely by several investigators (Chino, Demerec, Fujii, Kikkawa, Metz, Weinstein etc). One generation takes about 14 days at 26°C. Japanese name: *Kuro-Syôzyôbae.*

(22) *Drosophila subtilis* sp. nov.

Imagos: ♂ ♀ (Pl. XXXII) Arista with about four branches above and two below. Antennae dark brown; third joint blackish. Front over one-third width of head, slightly wider above; brown. Second orbital bristle two-thirds length of third, and one-half length of first. Orbital, ocellar and vertical bristles well developed. Second oral about one-half length of first, sometimes only one prominent oral bristle. Carina narrow and flat; face dark brown. A few prominent bristles on each palpus. Cheeks pale brown; their greatest width about one-fourth height of eye. Eyes pilose (Pl. XXX c).

Acrostichal hairs in eight rows; no prescutellars. Mesonotum and scutellum shining dark brown; with a whitish spot on each shoulder. Four indistinct brownish stripes on mesonotum. Pleurae brown with an indistinct dark brownish stripe on each side. Sterno-index about 0.9. Legs brown.

Abdomen dark brown, shining.

Wing dusky, pointed at the tip. Costal-index about 1.8; 4V-index about 2.2; 4c-index about 1.3; 5x-index about 1.3.

Length body 2.0 mm; wing 2.0 mm.

Eggs: Four filaments. In general, they are split into two or three at the tip. *Third larvae:* Hooklets blackish. The fully grown larvae can skip. *Pupae:* Posterior spiracles elongated and closed. *Chromosomes:* O-type (Pl. XXVIII). Testes are shown in Fig. 4 C.

Habitats: Gotenba (22), Simoda (24), Kyôto (29), Kôbe (40).

Remarks: Resembles *D. coracina* ♂ ♀. One generation takes about 20 days at 25°C. Japanese name: *Susubane-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(23) *Drosophila busckii* Coquillett 1901

D. busckii: Coquillett (1901) Ent. News, **12**: 18. Sturtevant (1921) Carnegie Inst. Wash., **301**: 77, Fig. 24; Pl. II 2. Duda (1924) Arch. f. Naturgesch., **90**: 221, Fig. 95. (1924) Entomologiske Meddelelser, **14**: 301–302, Fig. 29. Peng (1937) Annot. Zool. Japon., **16**: 24–25.

D. rubrostriata: Becker (1908) Mitt. Zool. Mus., **4**.

D. plurilineata: Villeneuve (1911) Wien. Ent. Zeit., **30**.

Imagos: ♂ ♀ Arista with about six branches above and two below. Antennae yellow; third joint dark brown. Front over one-half width of head, wider above; yellow. Second orbital bristle nearly as long as third which is about three-fourths length of first. Second oral nearly as long as first. Only one prominent bristle on each palpus. Carina high and slightly flat; face whitish. Cheeks whitish; their greatest width about one-third height of eye. Eyes with rather thick pile (Fig. 27).

Acrostichal hairs in eight rows; no prescutellars. Mesonotum and scutellum

yellow, with five dark brownish stripes on the mesonotum ; one median stripe being bifid behind and divergent. into two branches at the parts of dorsocentral bristles ; one in each dorsocentral line, does not reach the anterior margin of thorax ; one in each outer scutellar line, less dark and arises near the region of anterior dorsocentral bristle.   There is also a stripe running from just above the humerus to just above the wing.   Pleurae pale yellow, with three dark brownish stripes on each side ; one present below the humerus ; one long stripe runs across the mesopleurae, halteres and the margin of each dorso-lateral plate.   There is also a stripe formed by three blackish spots ; two on sternopleura, one on hypopleura.   Sterno-index about 0.3.   Legs yellow.   Apical bristles on first and second tibiae, preapicals evident only on third.

Fig. 27. Head of *D. busckii.*
×ca. 45.

Abdomen yellow, each segment with an apical black band that is interrupted in the mid-dorsal line, and attenuated or interrupted between that line and each lateral margin of abdomen.

Wing clear.   Costal-index about 3.0 ; 4V-index about 2.2 ; 4c-index about 1.0 ; 5x-index about 2.0.

Length body 2.0–2.2 mm ; wing 2.2–3.0 mm.

Eggs: Four filaments. *Third larvae:* The larva of this species bears on the dorsal surface of each segment from the fourth to the twelfth, about six branched processes. *Pupae:* Special processes on the dorsal surface may be of great use for distinguishing this species. *Chromosomes:* A-type (Pl. XXVIII).

Habitats: Sapporo (7), Innai (10), Niigata (13), Kanazawa (14), Kamisuwa (16), Kôhu (17), Gotenba (22), Kyôto (29), Tu (31), Oki (43), Tokuyama (46), Waihu (54), Amami-Ôsima (62), Syuotu (66), Keizyô (69).

Remarks: This is one of the cosmopolitan species and is widely distributed in Europe, North America, South America etc.   The genetics of *D. busckii* has been carried out by Warren (1920, Genetics 5 : 60–110).   One generation takes about 14 days at 26°C.   Japanese name : *Hyômon-Syôzyôbae.*

(24) *Drosophila funebris* Fabricius 1787

D. funebris: Fabricius (1787) Mant. Ens., 2, 345, 33 (as *Musca*).   Sturtevant (1921) Carnegie Inst. Wash., **301** : 84–86, Figs. 1, 3, 7, 16, 27 ; Pl. II 3.   Duda (1924) Entomologiske Meddelelser, **14** : 278–280, Figs. 15, 16.   (1925) Arch. f. Naturgesch., **91** : 147.   Matsumura (1931) Illustrated insects of Japan Empire, 367, Fig. 157.

Musca erythrophthalma: Panzer (1794) Fauna Germ., **17** : 24.   Not *D. funebris* Meigen (1830).

Imagos: ♂ ♀ Arista with about six branches above and four below. Antennae yellow ; third joint brown.   Front about one-half width of head, wider above ; yellowish brown.   Second orbital bristle about two-thirds length

of third, and one-half length of first.   A few prominent bristles on each palpus.
Carina broad and flat ; face yellowish brown.   Cheeks yellowish brown ; their
greatest width about one-third height of eye.   Eyes with thick pile.

Acrostichal hairs in eight rows ; no prescutellars.   Mesonotum and scutel-
lum slightly shining, reddish brown.   Sterno-index about 0.7.   Pleurae yellow
brown above, becoming yellow below.   Legs yellow.

Abdomen, in the male, shining black ;
basal four segments usually interrupted by
yellowish brown bands in the mid-dorsal part.
In the female, each segment has an anterior
yellowish band.   Hypopygium of the male
is shown in Fig. 28.

Wing clear ; vein brown.   Costal-index
about 3.5 ; 4V-index about 1.5 ; 4c-index
about 0.7 ; 5x-index about 1.0.

Length body 2.5–3.0 mm ; wing 2.5–3.0
mm.

Eggs : Four filaments.   *Third larvae :*
Hooklets colorless.   *Pupae :* Posterior spira-
cles divergent.   *Chromosomes :* G-type (Pl.
XXVIII).

Habitats : Ôtomari   (1),   Akkesi   (5),
Sapporo (7).

Fig. 28. Hypopygium of *D. funebris*
♂ . ×ca. 150.

Remarks : The body-color of young imago of this species is very light
as compared with that of an old one.   This species is one of the cosmopolitan
species and found commonly in north districts of palaearctic and nearctic regions.
The genetics of the species has been reported by several investigators (Spencer,
Timoféeff-Ressovsky).   One generation takes about 15 days at 26°C.   Japanese
name : *Suzi-Syôzyôbae* (*Tobiiro-Syôzyôbae*).

(25) *Drosophila grandis* sp. nov.

Imagos : ♂ Arista with about three branches above and two below.
Antennae brown.   Front over one-third width of head, wider above ; pale
yellow, with two dark brown longitudinal stripes.   Second orbital bristle
about one-third size of other two.   Only one prominent oral bristle.   A few
prominent bristles on each palpus.   Carina broad and flat, well developed ;
face pale yellow.   Cheeks blackish with slightly glitter ; their greatest width
about one-fourth height of eye.   Eyes with thick pile.   Proboscis yellow,
blackish brown at the tip.

Acrostichal hairs in six rows ; no prescutellars.   Mesonotum reddish brown,
with two yellowish stripes on both sides of each dorsocentral row.   Scutellum
reddish brown ; its margin yellow.   Pleurae black.   Sterno-index about 0.6.
Legs brownish yellow.   Coxa of prothoracic leg blackish.

Abdomen dark dull brown, with yellowish areas on lateral side of each
segment from the second to the fifth.

Wing clear. Costal-index about 2.0 ; 4V-index about 1.2 ; 4c-index about 1.0 ; 5x-index about 1.1. The first longitudinal vein blackish at the base (Pl. XXXI c).

Length body 4.0 mm ; wing 3.5 mm.

♀ Differs from the male in the following points: (1) Cheeks yellow except bucca ; (2) Coxa of prothoracic leg yellow ; (3) Pleurae yellow, with three dark brownish longitudinal stripes on each side.

Eggs : Four long filaments. *Larvae, pupae, chromosomes :* Unknown.

Habitats : Kôhu (17), Kyôto (29).

Remarks : Japanese name : *Munaguro-Syôzyôbae.* Cotypes are preserved in Zool. Inst., Kyôto Imp. Univ., Kyôto, Japan.

(26) *Drosophila histrio* Meigen 1830

  D. histrio : Meigen (1830) Syst. Beschr., 6. Duda (1924) Arch. f. Natur-gesch., **90** : 217, Fig. 87. (1924) Entomologiske Meddelelser, **14** : 285, Fig. 20.

  Not *D. histrio* Schiner (1864) *D. histrio* Oldenberg (1914).

Imagos : ♂ ♀ Arista with about five branches above and three below. Antennae brownish yellow. Front about one-third width of head, wider above ; yellow. Second orbital very fine, about one-fifth length of other two. Second oral about three-fourths length of first. A few prominent bristles on each palpus. Carina broad and flat ; face yellow. Cheeks yellow ; their greatest width about one-fifth height of eye. Eyes with rather thick pile.

Acrostichal hairs in eight rows ; no prescutellars. Mesonotum and scutellum reddish yellow, shining. Pleurae yellow. Sterno-index about 0.6. Legs yellow.

Abdomen yellow, with a dark brownish posterior band on each segment from the first to the fourth, which is interrupted in the mid-dorsal part. These bands become narrow and pale as they approach the lateral margin. There is generally a dark brown spot in the mid-dorsal part of the fifth segment.

Wing clear. Costal-index about 4.0 ; 4V-index about 1.5 ; 4c-index about 0.6 ; 5x-index about 0.9 (Pl. XXXI m).

Length body 3.0 mm ; wing 3.0 mm.

Eggs, larvae, pupae, chromosomes : Unknown, but Frolowa (1926) states that this species has a chromosome-complex corresponding to G-type in Pl. XXVIII.

Habitats : Sapporo (7), Kôhu (17).

Remarks : Somewhat resembles *D. immigrans* ♂ ♀. This species is probably endemic to palaearctic region. Japanese name : *Ezo-Syôzyôbae.*

(27) *Drosophila repleta* Wollaston 1858

  D. repleta : Wollaston (1858) Ann. Mag. Nat. Hist., **41** : 117. Knab (1912) Psyche, **19** : 106–109. Sturtevant (1921) Carnegie Inst. Wash., **301** : 99–101, Fig. 36. Duda (1924) Arch. f. Naturgesch., **90** : 221. (1924) Entomologiske Meddelelser, **14** : 299–300. (1925) Arch. f. Naturgesch., **91** : 168–169.

  D. punctulata : Loew (1862) Berlin Ent. Zeit., **6** : 232.

D. adspersa: Miki (1886) Wien Ent. Zeit., 5 : 328.

D. nigropunctata: van der Wulp (1892) ? Tijd. Ent., **34.**

D. marmoria: · Hutton (1901) ? Trans. N. Zeal. Inst., 33 : 91.

Imagos: ♂ ♀ Arista with about five branches above and three below. Antennae brown. Front over one-third width of head, wider above ; gray. Second orbital bristle about one-half size of other two. Only one prominent oral bristle. A few prominent bristles on each palpus. Carina distinctly sulcate ; face brown. Cheeks yellowish brown : their greatest width about one-fourth height of eye. Eyes with thick pile.

Acrostichal haris in eight rows. A pair of slightly enlarged hairs in the position of prescutellars. Mesonotum and scutellum gray ; each bristle and hair arising from a dark-brown dot ; these dots are irregularly fused into larger splotches. Pleurae brown. Legs pale brown ; first femora darker, first coxae dark-brown below.

Abdomen gray ; each segment with a wide interrupted dark brown band on its posterior margin ; these bands reach the anterior margin in near the lateral edges of the segments. There is also a gray spot between the above point and the lateral margin on the four basal segments. Hypopygium is shown in Fig. 29.

Wing clear ; first longitudinal vein black at the tip. Costal-index about 2.5 ; 4V-index about 1.8 ; 4c-index about 1.1 : 5x-index about 1.0 (Pl. XXXI i).

Length body 2.5 mm ; wing 2.5 mm.

Eggs: Four filaments. *Third larvae:* Hooklets colorless. *Pupae:* Posterior spiracles divergent. *Chromosomes:* I-type (Pl. XXVIII). Testes are shown in Fig. 4 B.

Habitats: Tôkyô (18), Ôsaka (33), Amami-Ôsima (62), Naha (63), Isigakizima (64), Taihoku (71).

Remarks: This species is very common all over the world. Sturtevant (1927) reports that *Drosophila hydei* which is very closely related to *D. repleta*, was obtained from Formosa. But, so far as our specimens collected from Formosa and other districts have been examined, only *D. repleta*, was found. One generation takes about 18 days at 26°C. Japanese name : *Madara-Syôzyôbae.*

Fig. 29. Hypopygium of *D. repleta* ♂. ×ca. 150.

VI. Catalogues of Japanese species of *Drosophila*

In this chapter are shown catalogues of species of Drosophilidae from Japan described by various investigators (from Saghalien, Hokkaido, Hondo, Sikoku, Kyûsyû, Ryûkyû Is., Formosa, Korea, Kwan-tung, Caroline Is.). In

addition to these, a list is given of Drosophilidae collected by T. Komai, F. T. Peng and by G. Tomita from China, and also a list of *Drosophila* collected by M. Chino and by M. Kariya from Manchukuo (Manchuria).

There are, however, several doubtful species in these catalogues. Especially, the species described by Duda (1922–1929) need to be reexamined, for his descriptions are chiefly based on the specimens which were sent by H. Sauter from Formosa. As pointed out by many investigators of Japan, Sauter's specimens are not always correct as to their habitats.

Abbreviation of the authors' names
Coqu.............Coquillett
Dolesch. ....Doleschall
Fall. ....Fallén
Matsu. ....Matsumura
de Meij. ....de Meijere
Walk. ....Walker
Woll............Wollaston
Zett. ....Zetterstedt

(1) Coquillett (1898)
Drosophila obscura Fall. (Hondo). (Probably *D. virilis* Sturtevant).
(2) Duda (1922), (1923), (1924 a), (1926), (1929)
Cacoxenus punctatus Duda (Formosa), *Drosophila ampelophila* Loew = *D. melanogaster* (Do.), *D. ananassae* de Meij. (Dolesch.) (Do.), *D. busckii* Coqu. (Do.), *D. clunicrus* Duda (Do.), *D. compressiceps* Duda (Do.), *D. curvicapillata* Duda (Do.), *D. decipiens* Duda (Do.), *D. dorsata* Duda (Do.), *D. hoozani* Duda (Do.), *D. lividinervis* Duda (Do.), *D. longifrons* Duda (Do.), *D. montium* de Meij. (Do.), *D. obscurata* de Meij. (Do.), *D. paravibrissina* Duda (Do.), *D. repleta*, Woll. (Do.), *D. silvata* de Meij. (Do.), *D. singularis* Duda (Do.), *D. unipectinata* Duda (Do.), *D. xanthogaster* Duda (Do.), *Hirtodrosophila carinata* Duda (Do.), *H. longecrinita* Duda (Do.), *H. long.* var. *curinervis* Duda (Do.), *H. long.* var. *dentata* Duda (Do.), *H. trapezina* Duda (Do.), *Incisurifrons* (*Drosophila*) *congesta* Zett. (Do.), *Leucophenga argentata* de Meij. (Do.), *L. bifasciata* Duda (Do.), *L. confluens* Duda (Do.), *L. fuscipennis* Duda (Do.), *L. guttiventris* de Meij. (Do.), *L. halteropunctata* Duda (Do.), *L. interrupta* Duda (Do.), *D. latifrons* Duda (Do.), *L. limbipennis* de Meij. (Do.), *D. lineata* de Meij. (Do.), *L. maculata* Dufour (Do.), *L. magnipalpis* Duda (Do), *L. Meijerea* Duda (Do.), *L. nigrinevis* Duda (Do.), *L. nigripalpis* Duda (Do.), *L. nigroscutellata* Duda (Do.), *L. setipalpis* Duda (Do.), *L. sordida* Duda (Do.), *L. subacutipennis* Duda (Do.), *L. subpollinosa* de Meij. (Do.), *L. umbratula* Duda (Do.), *L. varinervis* Duda (Do.), *Liodrosophila nitida* Duda (Do.), *Oxyphortica convergens* de Meij. (Do.), *Paradrosophila marginata* Duda (Do.), *P. novoguinensis* Duda (Do.), *P. oralis* Duda (Do.), *P. simplex* de Meij. (Do.), *P. scutellimargo* Duda (Do.), *P. subacuticornis* Duda (Do.), *Paramycodrosophila pictula* de Meij. (Do.), *Parascaptomyza graminum* var. *flava* Becker (Do.), *Phortica* (*Amiota*) *foliiseta* Duda (Do.), *P.* (*A.*) *variegata* Fall. (Do.), *Protho-*

stegana formorata Duda (Do.), *Scaptodrosophila divergens* Duda (Do.), *Spinulophila (Drosophila) albomicans* Duda (Do.), *S. (D.) annulipes* Duda (Do.), *S. (D.) signata* Duda (Do.), *S. (D.) tripunctata* Becker (Do.), *Spuriostyloptera multipunctata* Duda (Do.), *Stegana ingrolimbata* Duda (Do.), *Styloptera formosae* Duda (Do.), *Trichiaspiphenga invicta* Walk. (Do.).

(3) Enderlein (1922)

Zaprionus albicornis Enderlein (Formosa`.

(4) Esaki (1932)

Drosophila melanogaster Meigen (Hokkaido?, Hondo, Sikoku, Kyûsyû), *D. virilis* Sturtevant (Hondo, Sikoku, Kyûsyû).

(5) Kamizawa (1934 a), (1934 b)

Drosophila suzukii (Matsu.) (Hondo).

(6) Kikkawa and Peng (The present paper).

Amiota variegata Fall. (Hondo), *Apsinota obscuripes* de Meij. (Palao), *Chymomyza obscura* de Meij. (Hondo), 27 species of *Drosophila* (see the text).

(7) Kurisaki (1925)

Drosophila melanogaster Meigen (Hondo, Sikoku, Kyûsyû).

(8) Matsumura (1931)

Drosophila funebris Fall. (Hokkaido), *Leucophenga suzukii* Matsu.=*D. suzukii* (Matsu.) (Hondo), *D. histrio* f. *jezonica* Matsu. (Perhaps *D. nigromaculata sp. nov.* (Hokkaido).

(9) Sturtevant (1921), (1927)

Drosophila hydei Sturtevant (Formosa), *D. immigrans* Sturtevant (Do.), *D. immigrans* var. *formosana* Sturtevant (Do.), *D. melanogaster* Meigen (Hondo, Kyûsyû, Formosa), *D. nasuta* Lamb (Formosa), *D. takahashii* Sturtevant (Do.).

(10) Takahashi, R. (1934) *Drosophila* species preserved in the Dept. Agric. Research Inst., Government of Formosa. (Identified by Prof. T. Shiraki).

Amiota orientalis Hendel (Formosa), *Drosomyiella abbreviata* de Meij. (Do.), *Drosophila ampelophila* Loew=*D. melanogaster* Meigen (Do.), *D. ananassae* de Meij. (Dolesch.) (Do.), *D. dorsata* Duda (Do.), *D. montium* de Meij. (Do.), *D. obscurata* de Meij. (Do.), *D. repleta* Woll. (Do.), *D. silvata* de Meij. (Do.), *D. tristipennis* Duda (Do.), *D. unipectinata* Duda (Do.), *D. xanthogaster* Duda (Do.), *Incisurifrons (Drosophila) congesta* Zett. (Do.), *Leucophenga argentata* de Meij. (Do.), *L. guttiventris* de Meil. (Do.), *L. halteropunctata* Duda (Do.), *L. interrupta* Duda (Do.), *L. lineata* de Meij. (Do.), *L. nigroscutellata* Duda (Do.), *L. paraguttiventris* de Meij. (Do.), *L. subacutipennis* Duda (Do.), *Orthostegana curvinervis* Hendel (Do.), *O. nigripennis* Hendel (Do), *Oxyphortica convergens* de Meij. (Do.), *Paradrosophila scutellimargo* Duda (Do.), *Paraleucophenga triseta* Hendel (Do.), *Parascaptomyza graminum* de Meij. (Do.), *Phortica (Amiota) varigata* Fall. (Do.), *Spinulophila (Drosophila) annulipes* Duda (Do.), *S. (D.) tripunctata* Becker (Do.), *Thaumastophila hyalipennis* Hendel (Do.), *Trichiaspiphenga invicta* Walk. (Do.).

Drosophila species of China

(1) Peng (1937) (July, 1936).

´Amiota variegata Fall. (Lushan), Drosophila ananassae Doleschall (Shanghai), D. auraria Peng (Lushan, Nanchang, Sanhu), D. busckii Coquillett (Lushan), D. immigrans Sturtevant (Lushan, Sanhu), D. melanogaster Meigen (Lushan, Nanchang), D. suzukii (Matsu.) (Sanhu), D. takahashii Sturtevant (Sanhu), D. sp. (Lushan).

(2) Komai (Oct., 1936).

Drosophila melanogaster Meigen (Peking=Peiping), D. montium A de Meij. (Ningpo), D. takahashii Sturtevant (Hangchow), D. virilis Sturtevant (Peking= Peiping, Hangchow).

(3) Tomita (Oct., 1936).

Drosophila ananassae Doleschall (Shanghai).

Drosophila species of Manchukuo (Manchuria)

(1) Chino (1937).

Drosophila repleta Woll. (Hôten, Sinkyô) He obtained this species from Mozi (Kyûsyû) and Tairen (Kwan-tung) respectively.

D. virilis Sturtevant (Kirin=Kiturin, Sinkyô).

(2) Kariya (Aug., 1937).

Drosophila auraria Peng (Yûgakuzyô), D. melanogaster Meigen (Do.), D. takahashii Sturtevant (Do.).

VII. Summary

The following 27 species of Drosophila found in Japan and adjacent localities, were described ; of these 11 species seem to be new to science. The identification was based on the studies of imagos, eggs, larvae, pupae, chromosomes and of other diagnostic features.

  (1) D. coracina sp. nov.
  (2) D. immigrans Sturtevant 1921
  (3) D. komaii sp. nov.
  (4) D. ananassae Doleschall 1858
  (5) D. bipectinata Duda 1923
  (6) D. auraria Peng 1937
  (7) D. rufa sp. nov.
  (8) D. montium de Meijere 1916
  (9) D. nipponica sp. nov.
 (10) D. ficusphila sp. nov.
 (11) D. bizonata sp. nov.
 (12) D. lutea sp. nov.
 (13) D. takahashii Sturtevant 1927

(14) *D. melanogaster* Meigen 1830

(15) *D. simulans* Sturtevant 1919

(16) *D. suzukii* (Matsumura) 1931

(17) *D. nigromaculata sp. nov.*

(18) *D. transversa* Fallén 1823

(19) *D. melanissima* Sturtevant 1921

(20) *D. sordidula sp. nov.*

(21) *D. virilis* Sturtevant 1916

(22) *D. subtilis sp. nov.*

(23) *D. busckii* Coquillett 1901

(24) *D. funebris* Fabricius 1787

(25) *D. grandis sp. nov.*

(26) *D. histrio* Meigen 1830

(27) *D. repleta* Wollaston 1858

In the last chapter, are presented catalogues of Japanese species of Drosophilidae reported by previous investigators, and also lists of *Drosophila* collected from China and Manchukuo (Manchuria).

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Explanation of Plates

Plate XXVII

Schematic structure of *Drosophila komaii*.

A and B (Head and thorax. Left, side view; right, dorsal view, ×ca. 30)
AB=Abdomen
AC—Acrostichal hairs. Several rows of acrostichal hairs between the dorsocentral rows are very convenient for taxonomic study. Unless otherwise stated, the count is to be taken just in front of the anterior dorsocentral bristles.
AN=Antenna
AR=Arista
BU=Bucca
CH=Cheek
CO-1, CO-2, CO-3=Coxa-1, Coxa-2, Coxa-3
DC (A, P)=Dorsocentrals (Anterior, Posterior)
FR=Front
HA=Haltere
HP=Hypopleura
HU=Humerus
HUM (U, L)=Humerals (Upper, Lower)
ME=Mesonotum
MS=Mesopleura
MST=Mesosternal
MT=Metanotum
OB-1, OB-2=Oral-1 (First oral or first vibrissa), Oral-2 (Second oral or second vibrissa)
OC=Ocellus
OCL=Ocellar
OR-1, OR-2, OR-3=Orbital-1 (First orbital or posterior reclinate orbital), Orbital-2 (Second orbital or anterior reclinate orbital), Orbital-3 (Third orbital or proclinate orbital)
P=Palpus
PA (A, P)=Post-alars (Anterior, Posterior)
PP=Position of prescutellars (Absent in this species)
PSR=Presutural
PT=Pteropleura
PV=Postvertical
SA (A, P)=Supra-alars (Anterior, Posterior)
SC (A, P)=Scutellars (Anterior, Posterior)
SCT=Scutellum

STP (A, M, P)=Sternopleurals (Anterior, Middle, Posterior)
V (A, P)=Verticals (Anterior, Posterior)
C (Frontal view of head. ×ca. 30)
AN=Antenna
CA=Carina
E=Eye
FA—Face
OB-1, OB-2=Oral-1, Oral-2
OC=Ocellus
OCL=Ocellar
OR (1, 2, 3)=Orbitals (1, 2, 3)
P=Palpus
PR=Proboscis
PV=Postverticals
V (A, P)=Verticals (Anterior, Posterior)
D and E (Abdomens. ×ca. 30)
1T-8T—First tergite — Eighth tergite
2S-7S=Second sternite — Seventh sternite
AP=Anal plate
C=Clasper
HA=Haltere
GA—Genital arch
SP=Spiracle
F (Male-Hypopygium. ×ca. 150)
AP—Anal plate
C=Clasper
GA=Genital arch
G (Prothoracic leg. ×ca. 60)
APL—Apical bristle
CL=Claw
CO=Coxa
FE=Femur
PAPL=Preapical bristle
TA 1, 2, 3, 4, 5=Tarsal joints (First, second, third, fourth, fifth)
TI=Tibia
TR=Trochanter
H (Wing. ×ca. 30)
I-BC=First basal cell
II-BC=Second basal cell
I-PC=First posterior cell
II-PC=Second posterior cell
III-PC=Third posterior cell
AC=Anal cell
ACV=Anterior crossvein

AL=Alula
ANCV=Anal crossvein
AUX=Auxiliary cell
CC=Costal cell
CSV(MV)=Costal or marginal vein
DC=Discal cell
HCV=Humeral crossvein
LI-LVI=Longitudinal veins (First—Sixth)
PCV=Posterior crossvein
SMC=Submarginal cell

Technical terms:
Acrostichal hairs: See A and B
Sterno-index: The length of anterior sternopleural divided by the length of posterior sternopleural bristle.

Costal-index: The length of second section of the costal vein divided by the length of its third section.

4V-index: The length of fourth (distal) section of the fourth vein (LIV) divided by the length of its third section.

4c-index: The length of third section of the costal vein divided by the length of third section of the fourth vein (LIV).

5x-index: The length of third (distal) section of the fifth vein (LV) divided by the length of the posterior crossvein.

PLATE XXVIII

Chromosome types of *Drosophila* species

PLATE XXIX

Map of geographic distribution

PLATE XXX

"Sump" photographs of *Drosophila*

a. Photograph showing hooklets on the ventral surface of the larva (*D. melanogaster*). ×ca. 130.
b. Magnified photograph of the above.

c. Compound eye of *D. subtilis*. ×ca. 600.
d. The same of *D. immigrans*. ×ca. 600.

×ca. 600.

PLATE XXXI

Wings of *Drosophila* species. ×ca. 12.

a. *D. coracina*
b. *D. immigrans*
c. *D. grandis*
d. *D. nigromaculata*
e. *D. ananassae*
f. *D. bizonata*
g. *D. auraria*
h. *D. sordidula*
i. *D. repleta*

j. *D. melanissima*
k. *D. virilis*
l. *D. suzukii*
m. *D. histrio*
n. *D. melanogaster*
o. *D. takahashii*
p. *D. lutea*
q. *D. ficusphila*
r. *D. subtilis*

PLATE XXXII

Total figures of *D. suzukii*, *D. komaii*, *D. virilis* and *D. subtilis*. ×ca. 20.
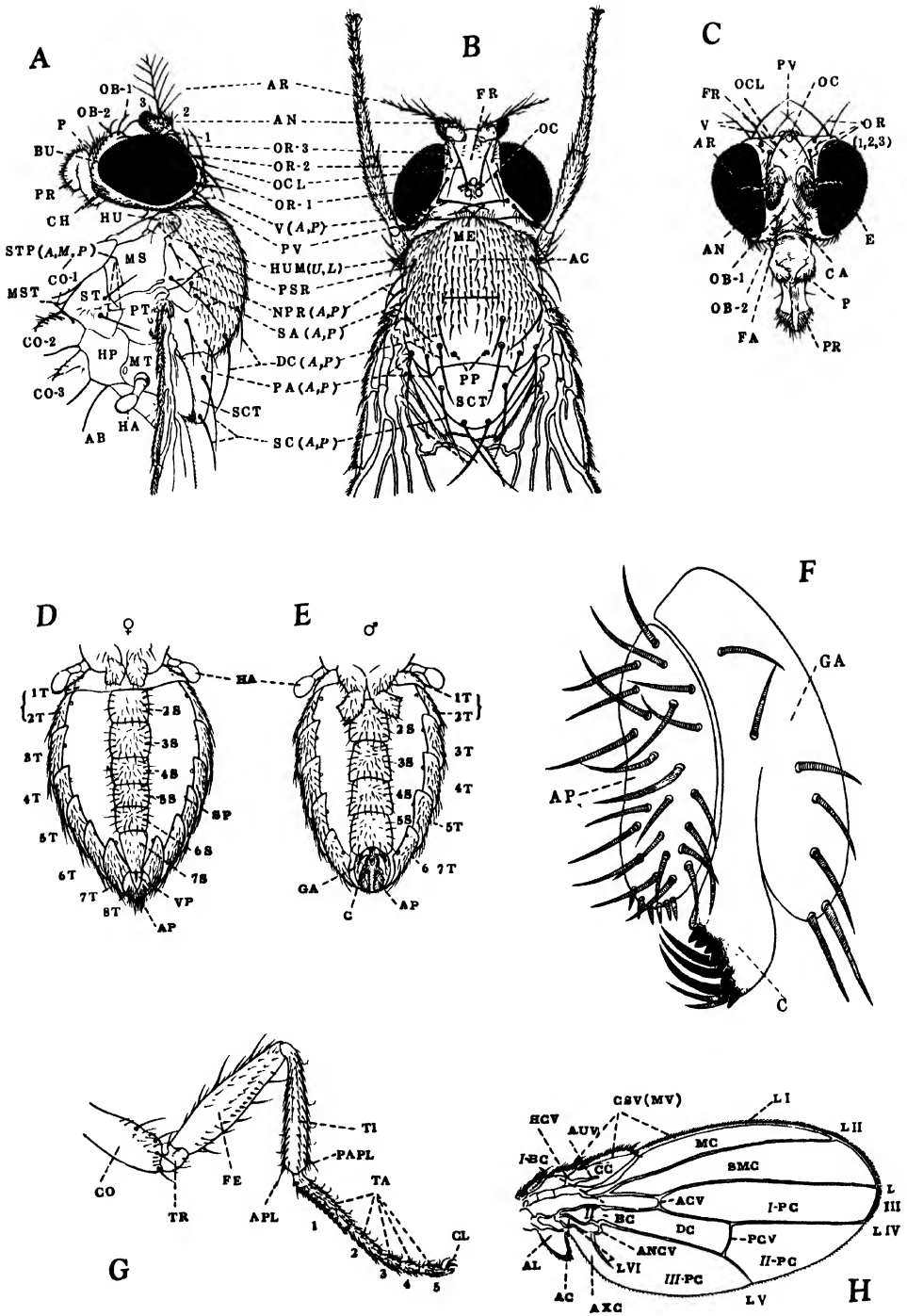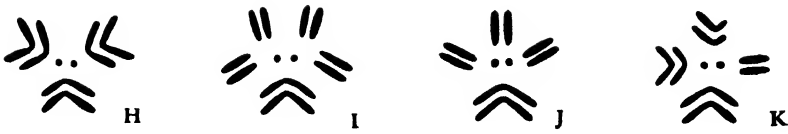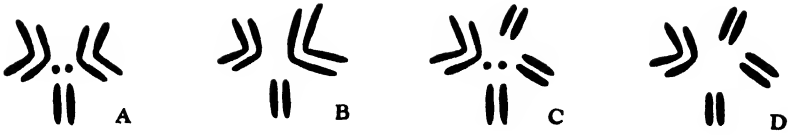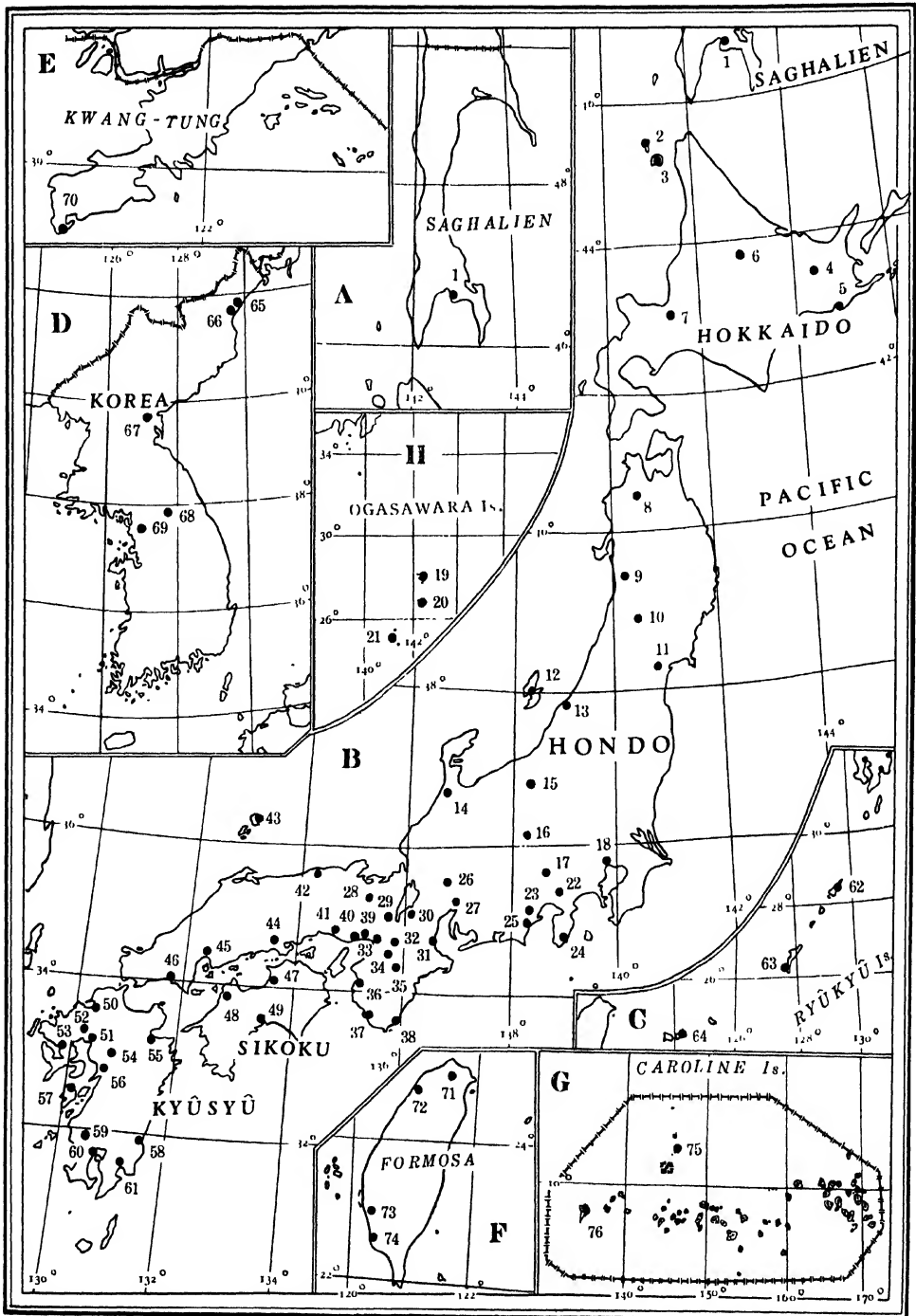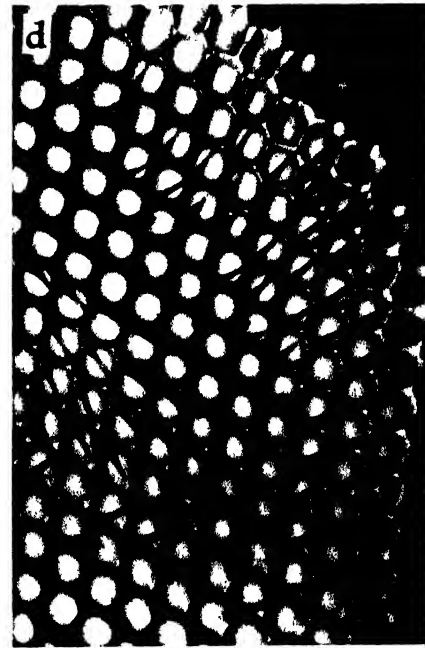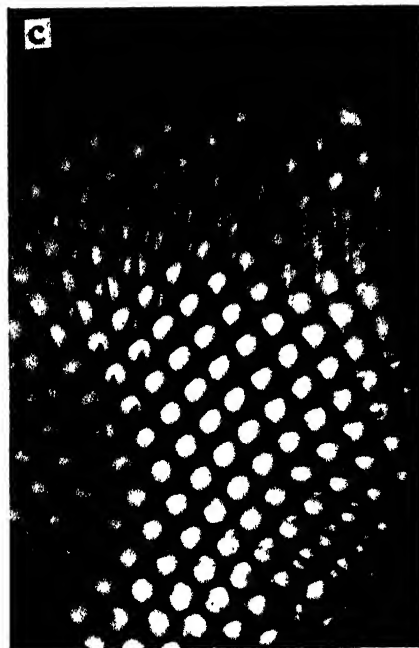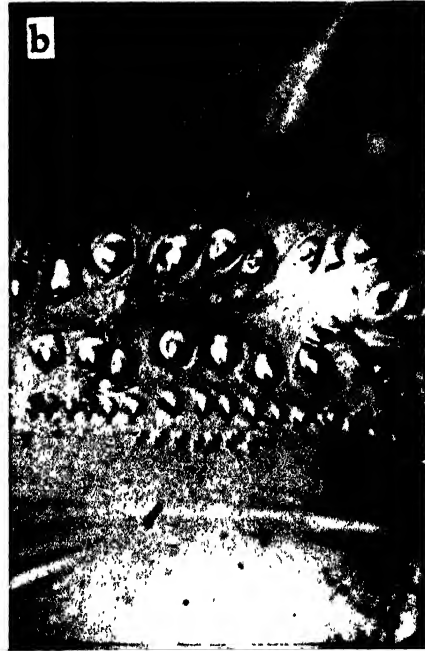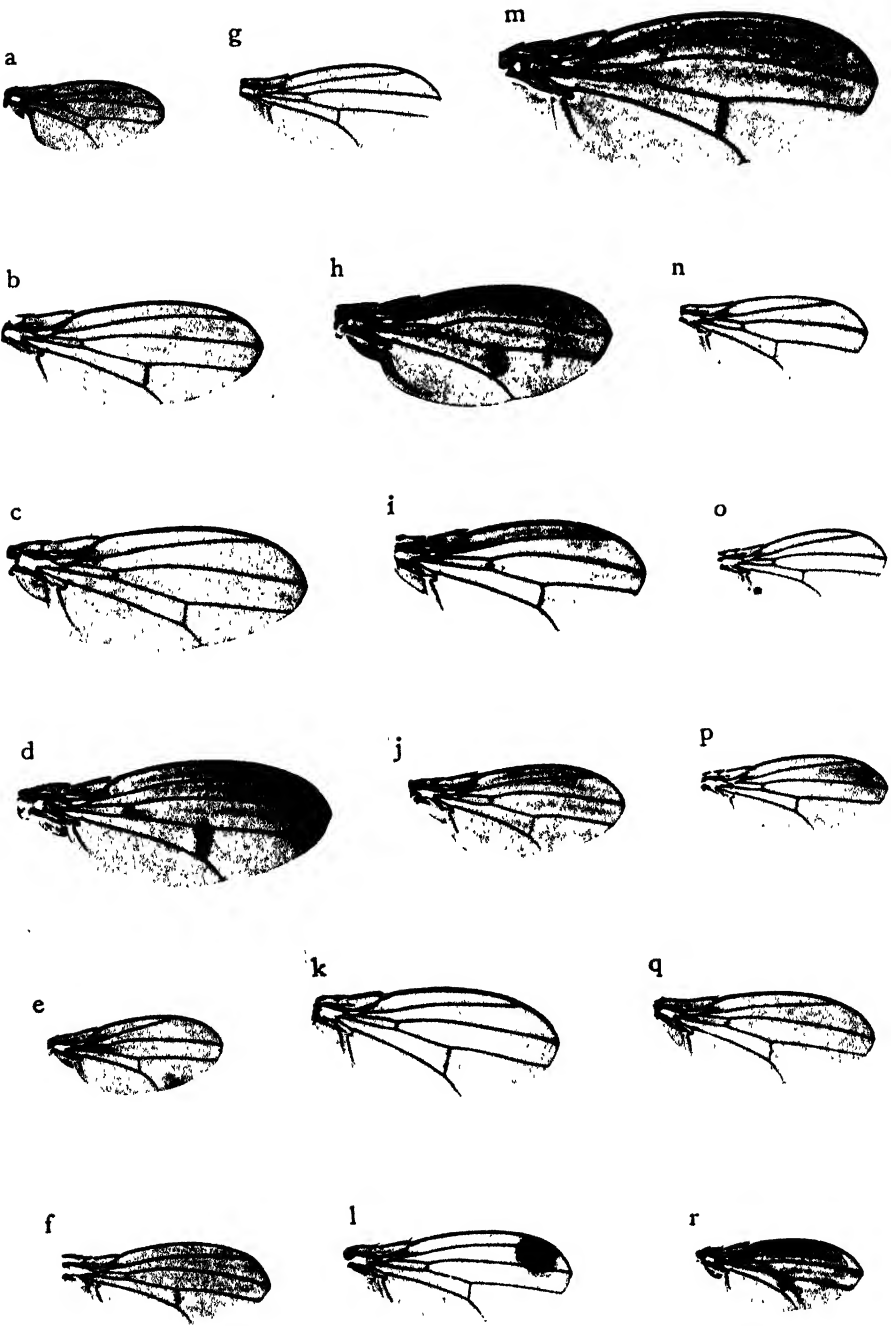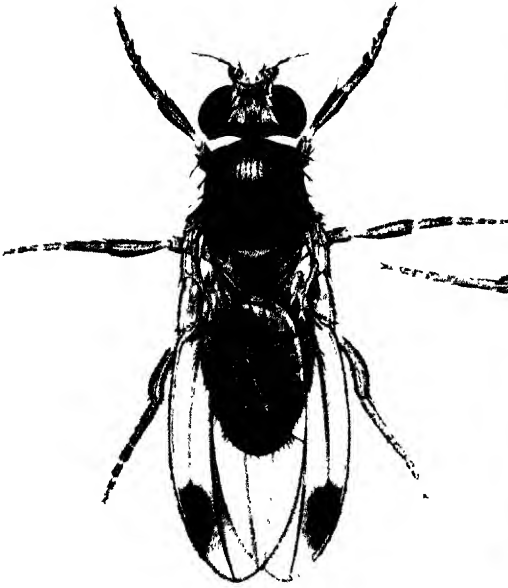
D. suzukii ♂

D. koman ♂
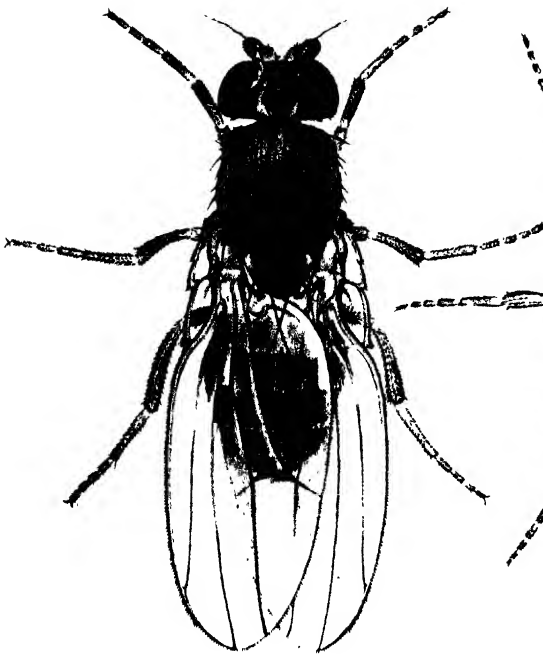
D. virilis ♂
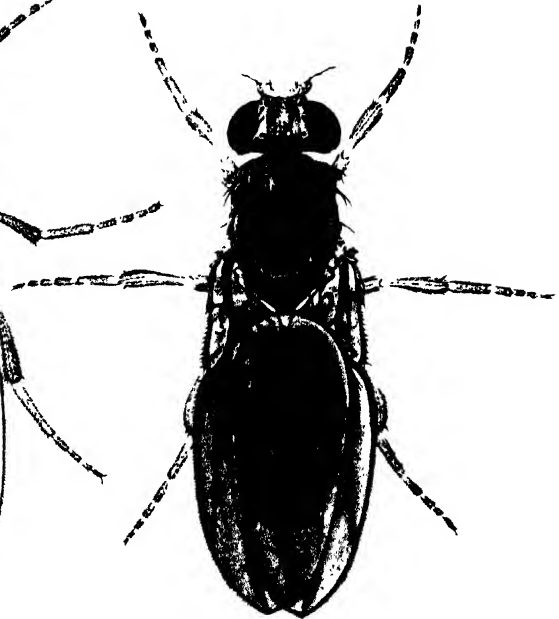
D. subtilis ♀

24. Studies on the Helminth Fauna of Japan
Part 22. Two New Species of Frog Cestodes

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(With Plates XXXIII–XXXV)

Of the frog cestodes none has yet been reported from Japan, and it is after a long search that I have found two species of them, one from *Rana nigromaculata* Hallowell and the other from *Rana japonica* Günther.

From *Hyla arborea japonica* Günther and *Rhacophorus schlegeli* var. *arborea* Okada et Kawano also have been obtained some examples, but the specific identification is not possible at present owing to absence of full-grown segments.

Ophiotaenia ranae n. sp.
Pl. XXXIII, Figs. 1–4; Pl. XXXV, Figs. 9–12.

Rana nigromaculata from Lake Kobata near Kyôto was found infected in the small intestine with large numbers of the tapeworm described below.

As fixed in alcohol, stained and mounted, the worm is over 16 cm long, comprising more than 370 segments, with a maximum breadth of 2.08 mm at the anterior mature segments, whence it tapers gradually toward the posterior extremity. The scolex, 0.31–0.33 mm dorsoventrally and 0.32–0.38 mm transversely, has four prominent suckers 0.15–0.2 mm across in a dorsal and ventral pair. It is more or less distinctly constricted immediately behind the suckers. In youngest unsegmented examples a well-defined rounded or disk-shaped glandular organ (Fig. 4 a) is seen at the apex. It is 0.12–0.14 mm in diameter and packed with fine eosinophil secretion granules produced by the gland cells, which are pressed against the membranous capsule and contain a pyknotic nucleus and basophil protoplasmic granules. A vestige of this organ may occasionally be observed even in larger examples. The neck is 2.5–5.5 mm long and widens posteriorly. The short immature segments become longer and broader posteriorly and attain the maximum breadth when the eggs begin to appear in the uterus. The gravid segments are almost uniform in breadth and have inconspicuous intersegmental notches on the lateral margins. Their length and breadth are very variable; some are broader than long and others longer than broad, especially so when the uterus is emptied or senile atrophy sets in. In strongly atrophied segments the maximum length is 1.38 mm and the breadth only 0.4 mm.

The cuticle is 4–6 μ thick. The subcuticular muscle and cell layers are well differentiated, while the dorsoventral muscles are not developed. The

inner longitudinal muscle bundles are very close to each other and form a distinct sheath for the medullary parenchyma. The lateral nerve trunk lies just inside this muscle sheath, and immediately dorsal to the cirrus pouch and vagina on the pore side. The wide ventral excretory stems run just inside the ventral inner longitudinal muscle about one-fifth to one-seventh of the proglottis breadth from the lateral margins in mature and gravid segments, with a transverse anastomosis between at the posterior end of each segment. The narrow, thick-walled dorsal excretory stems lie at about the middle of the medulla in the same sagittal plane as the ventral or slightly inside or outside of it, between the outer and the inner group of the testes and along the outer margins of the ovary. On the pore side they pass through the narrow space between the dorsal inner longitudinal muscle and the terminal genital organs (cirrus pouch and vagina). At the scolex inside the four suckers there is a complete ring (Fig. 1 r) formed by the dorsal and ventral stems of the two sides, besides supplementary communications between the two stems of the same side.

The follicular testes extend in two lateral fields between the vitellaria and the uterus from the anterior end of the segment to the level of the anterior end of the ovary; they are divided by the excretory stems into a smaller outer and a larger inner group and interrupted on the pore side by the terminal genitalia. Their number varies greatly according to proglottides: the outer group consists of 10–15 testes and the inner of 25–70, the total number not exceeding 115 on one side. Generally speaking they are more numerous in immature proglottides than in mature and gravid ones. The vas deferens is strongly convoluted at the posterior half of the anterior third of the segment between the cirrus pouch and the median line. The elongate oval or club-shaped cirrus pouch extends a little further inwards than the excretory stems, but when the cirrus is extruded it becomes smaller and barely reaches to that limit. It contains at the base a convoluted ductus ejaculatorius, whose distal portion is relatively wide and well eversible. The cirrus is slender and somewhat swollen at the base and may attain a length of about 0.4 mm when fully protruded. The genital sinus, opening on the lateral margin at about the middle of its anterior third indifferently on the right or left, appears as a somewhat inconspicuous notch but may often be obliterated.

The two-winged ovary extends transversely at the posterior end of the segment between the excretory stems. As the development proceeds, the two lobulated outer ends of the ovary become enlarged anteroposteriorly, so that the entire organ assumes an H- or an inverted M-shape. After joining the vagina the germiduct is thrown into convolutions in the median line behind the ovary and then unites with the vitelline duct. The sinuous uterine duct proceeeds forwards in the median line on the dorsal side of the ovary and uterus and opens into the latter at about the middle of the segment. The median uterus extending between the anterior end of the segment and the ovary sends out a number of lateral pouches filled with eggs. When fully distended it occupies the middle half of the segment and empties the eggs

through the ventral median slit formed by its rupture. After the eggs have been discharged the uterine pouches show irregular secondary diverticula. The vagina running forward on the dorsal side of the uterine stem passes immediately in front of the vas deferens and anterodorsal to the cirrus pouch, and opens into the genital sinus anterior and dorsal to the male pore. The finely acinous vitellaria extend in the lateral marginal medulla throughout the proglottis length, partly overlapping the outer group of the testes and intruding into the cortex through the space between the inner longitudinal muscle bundles. The vitelline ducts from the two sides run transversely ventral to the ovary and unite with each other slightly to the right of the median line to form a short common duct joining the germiduct.

In the fresh state the transparent outer egg shell is 28–45 μ and the inner 21 μ in diameter. The oncosphere is usually oval and 13–15 μ long, and its hooks are 6 μ long. As fed to *Mesocyclops dybowskyi* (Lande)* the oncosphere liberated itself in the midgut of the copepod and penetrated into the body cavity (Fig. 11), where it grew in a week into a procercoid (Fig. 12) provided with four suckers measuring each 40 μ in diameter, an apical organ consisting of a rosette-shaped mass of elongate glandular cells, and a small caudal vesicle containing three pairs of embryonic hooks. Further development of the worm is reserved for a future study.

This species is characterized by the vitellaria intruding into the cortex through the longitudinal muscle sheath. In this respect it differs from any of the Proteocephalids recorded from the frog, such as *Proteocephalus tigrinus* Woodland, 1925, *Ophiotaenia schultzei* (Hungerbühler, 1910), *O. magna* Hannum, 1925, *O. saphena* Osler, 1931 and *O. olor* (Ingles, 1936). That the testes extend laterally to the excretory stems in the present species is also worth noting.

Crepidobothrium olor Ingles, 1936, should be transferred to *Ophiotaenia* La Rue on account of absence of marginal notches on the suckers. I agree with La Rue in considering *Crepidobothrium* as distinct from *Ophiotaenia*, because the large, swollen scolex combined with large suckers with notched margins is a very prominent distinguishing feature of more than specific significance.

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*Identified by Dr. M. Uéno, to whom I with to express my best thanks here.

Baerietta japonica n. sp.
Pl. XXXIV, Figs. 5–8; Pl. XXXV, Figs. 13–14.

Unless otherwise stated the following description is based on three series of transverse sections and a number of mature specimens fixed in acetic sublimate under cover glass pressure and stained with Heidenhain's hematoxylin.

The filiform, cylindrical strobilus is up to 27 mm long, with a maximum breadth of 0.7 mm* at about the middle, whence it tapers gradually toward the extremities. The scolex is rounded in front and bears four suckers 54–84 μ in diameter and passes imperceptibly into the long slender neck. The immature as well as mature segments are definitely broader than long and have smooth lateral margins, without indication of external segmentation, and are distinguishable from one another only by the genital sets. As the parauterine organs begin to be hollowed out for the eggs the segments become elongated and swollen at the middle to take a barrel-shape and measure 0.15–0.25 mm long by 0.12–0.21 mm broad.

The cuticle, up to 3 μ thick, is beset with exceedingly minute spines all over except at the head end. The underlying muscles are weakly developed. The subcuticular cells are large and form a very conspicuous layer. The inner longitudinal muscle sheath is moderately well developed except in the postmature segments, where it is markedly atrophied. The dorsal and ventral excretory stems lying at about the middle of each lateral half of the body are united at the scolex (Fig. 5) and rather coarsely undulating in the anterior region irrespective of the internal segmentation, without any transverse anastomosis in each segment, but sooner or later the ventral stems enter into cross-anastomosis at the posterior end of each segment. The dorsal stems are relatively wide anteriorly, but are barely recognizable posteriorly. The nerve cord lies on each side just inside the longitudinal muscle sheath. Some distance, at most 7 mm, behind the head, the male genital anlagen appear in the dorsal medulla. The genital pore is not found yet at this stage of development, but as soon as the female genital anlagen appear in the ventral medulla the genital pores open to the outside on the lateral margins, indifferently on the right or left, the two succeeding occasionally fused together. In the post-mature segments, however, they tend to disappear together with the terminal genital ducts of both sexes.

The two testes are rather rounded in mature segments, measuring 17–24 μ by 21–72 μ, and lies in the dorsal part of the medulla, one dorsal to the uterus and the other dorsal to the ventral excretory stem. The vas deferens, formed by union of the two short vasa efferentia arising from the inner ends of the testes, may be distended with spermatozoa in form of a tubular vesicula seminalis and is more or less strongly convoluted, though stretched in the posterior segments. The club-shaped cirrus pouch, 30–48 × 18–26 μ and containing a more or less spirally twisted ductus ejaculatorius and numerous small cells with rounded nuclei, has relatively thin muscular wall and lies in the lateral

* Exaggerated by pressure applied on cover glass.

field with its swollen base intruding into the medulla anteriorly but immediately outside the longitudinal muscle sheath posteriorly. With the development of the para-uterine organs it tends to degenerate and disappears almost completely in the posterior region where the eggs are found in the para-uterine organs. There is a small genital atrium lined by cuticle, into which opens the ductus ejaculatorius and immediately behind it the vagina.

The ovary appears in the ventral part of the medulla some distance behind the testicular anlage. When fully developed it is oval, 27–33 μ by 38–48 μ and is filled with a number of large germ cells all at the same stage of development. The germiduct arising from the dorsal side of the ovary runs dorsad and after joining the vagina unites with the short duct from the vitellarium to form the uterus. The germ cells are pushed one after another into the uterus, while the ovary disappears and the germiduct distended with ova forms part of the uterus. At the anterior wall of the uterus soon appears a reticular para-uterine organ and as it develops it is divided in front into two parts, a dorsal and a ventral, and is surrounded at each anterior end by very compact parenchyma appearing like a dark spot. From the apex of each para-uterine organ is budded out anteriorly a small diverticle (Fig. 13), which becomes enlarged posteriorly into a rounded chamber as the reticular tissue of the para-uterine organ degenerates. Thus are formed two hollow para-uterine organs communicating with each other at the base and containing a small number of eggs, which are now fully mature. There are from five to nine eggs in each full-grown segment. The uterus proper tends to degenerate as the para-uterine organ develops and finally disappears when the latter serves as egg reservoir. The immature eggs are free in the uterus and not enclosed in capsules. This fact accounts for easy transfer of eggs from the uterus to the para-uterine organ. Inside the pliant outer shell, which is readily mistaken for a uterine or egg capsule, there is a clear space occupied by some liquid, yolk granules and vesicular nuclei of degenerating yolk cells. In mature eggs the outer shell assumes a more definite oval form and measures 36–42 μ by 25–30 μ and contains homogeneous substance. The thick embryonic shell is 23–30 μ by 18–24 μ and the hooks are 12–15 μ long in life. The vitellarium is oval, measuring 20–27 μ by 27–30 μ and lies dorsal to the ovary, but as the uterus develops it becomes atrophied and lies immediately posterior or posteroventral to the uterus, and finally disappears completely. The very narrow vagina opening into the genital atrium immediately behind the male genital pore runs inwards behind the cirrus pouch and vas deferens, but in gravid segments its connection with the part of the uterus corresponding to the original germiduct is unable to trace. With the disappearance of the male terminal ducts the vagina is also no more recognizable.

Habitat. Small intestine of *Rana japonica* Günther.

Locality and date. Near Okayama; August 21, 1937.

Type and paratypes in Yamaguti Helminthological Collection.

A similar worm was found in the small intestine of *Hyla arborea japonica* Günther from Suwa, Nagano Prefecture, and of *Rhacophorus schlegelii* var.

arborea Okada et Kawano from near Kyoto, but since the specimens are not ﹀ yet fully mature, the specific identification is not possible.

This species resembles *Baerietta baeri* Hsü, 1935, in the number of testes and para-uterine organs, but differs from it in egg size. It seems very likely that the uterine capsule observed by Hsü is nothing but the outer egg shell.

<div align="center">

LITERATURE

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<div align="center">

EXPLANATION OF PLATES

Pl. XXXIII. *Ophiotaenia ranae* n. sp.

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Fig. 1. Scolex; ventral view.
Fig. 2. Gravid segment; ventral view.
Fig. 3. Segment with empty uterus; ventral view.
Fig. 4. Section of scolex of youngest example showing apical organ; ×200

<div align="center">

Pl. XXXIV. *Baerietta japonica* n. sp.

</div>

Fig. 5. Scolex; ventral view.
Fig. 6. Mature segments; lateral view.
Fig. 7. Mature segments with reticular para-uterine organs; ventral view.
Fig. 8. Gravid segment with hollow para-uterine organs; ventral view.

<div align="center">

Pl. XXXV.

</div>

Fig. 9–10. Transverse sections of *Ophiotaenia ranae*.
Fig. 11. *Mesocyclops dybowskyi* used for infection experiment, ×25.
Fig. 12. Same infected with procercoid of *Ophiotaenia ranae*, ×100; 7 days after infection.
Fig. 13. *Baerietta japonica* showing uterus proper filled with eggs and reticular para-uterine organs with anterior diverticles; ventral view.
Fig. 14. Transverse section of *Baerietta japonica* showing two hollow para-uterine organs containing full-grown eggs, ×200.

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ABBREVIATIONS USED IN FIGURES

</div>

a apical organ, *at* genital atrium, *cp* cirrus pouch, *d* vas deferens, *dv* dorsal excretory vessel, *e* egg, *fc* fertilization canal, *gp* genital pore, *il* inner longitudinal muscle, *n* nerve trunk, *o* ovary, *p* procercoid, *pu* para-uterine organ, *r* excretory ring, *s* sucker, *sg* shell gland, *t* testis, *ta* transverse anastomosis, *u* uterus, *vg* vagina, *vd* vitelline duct, *vt* vitellaria, *vv* ventral excretory vessel.

9

n *vt dv* *t.* *d* *u* *t* *dv* *vt* *n*

at

cp *vv* *vg* *il* *vv*

0.5 mm

10

n *vt* *dv* *fc* *vg* *o* *dv* *n*

vv *il* *vv* *vt*

0.5 mm

14

13

0.05 mm

12

p

11
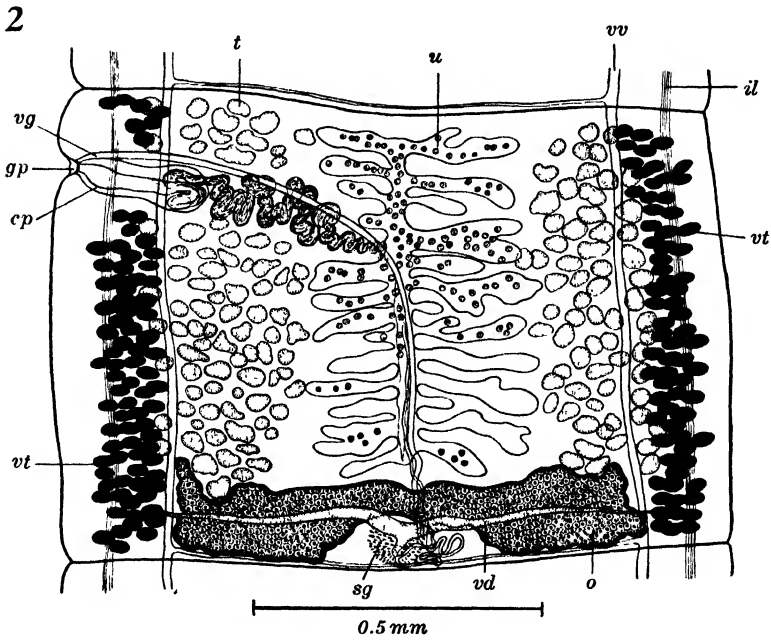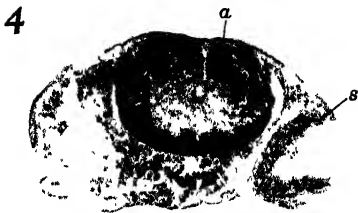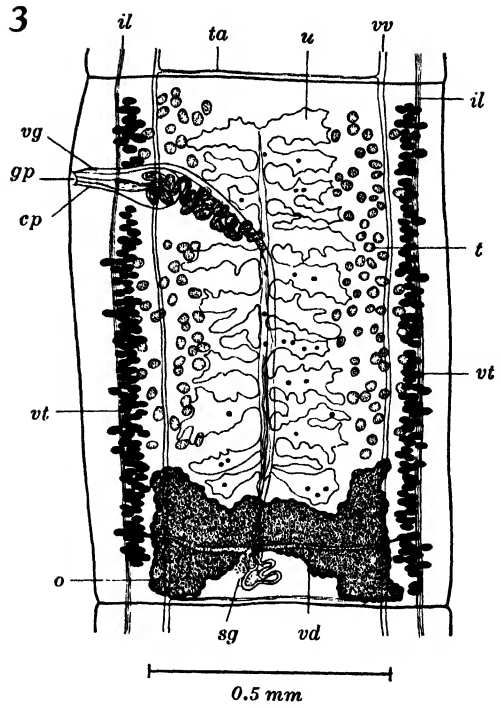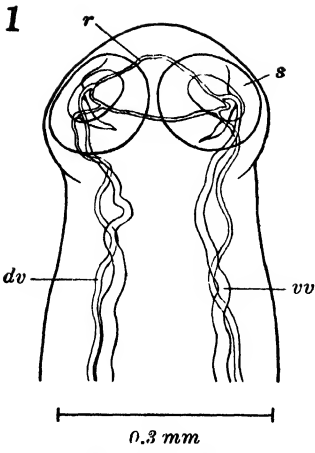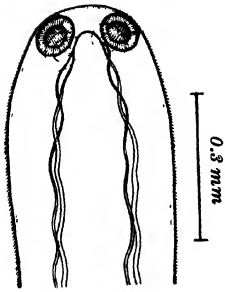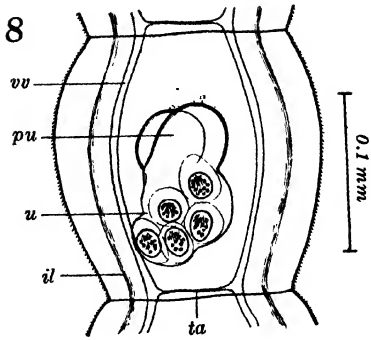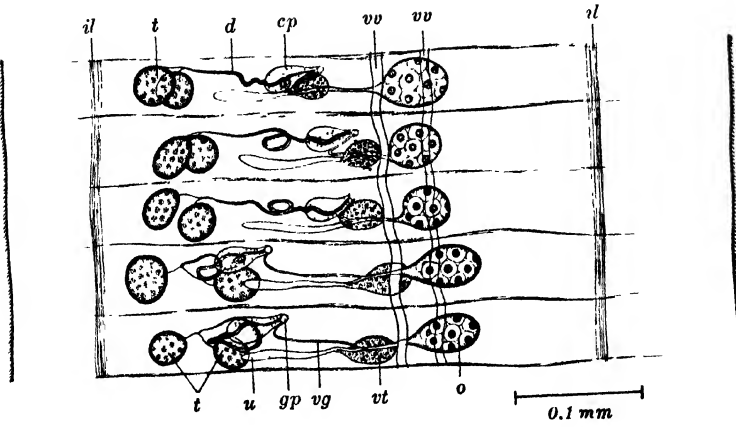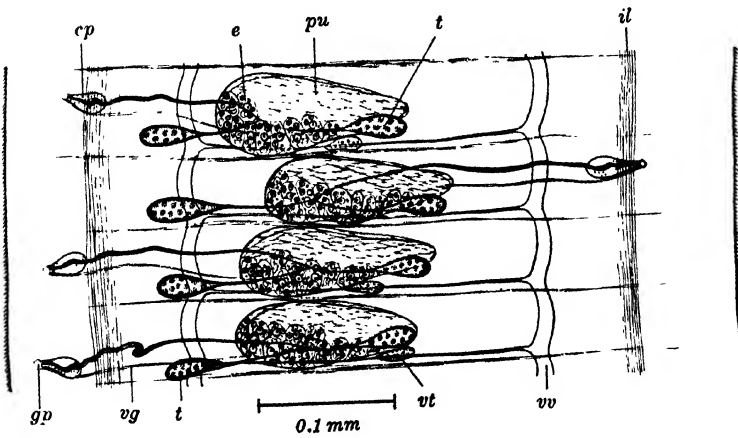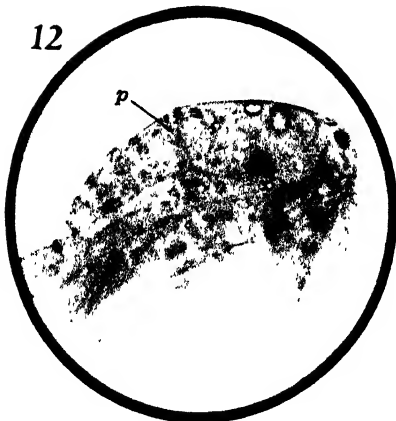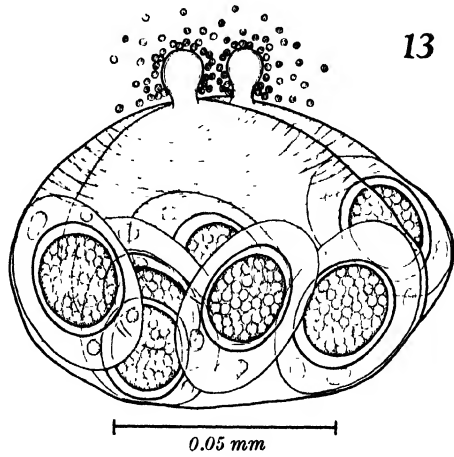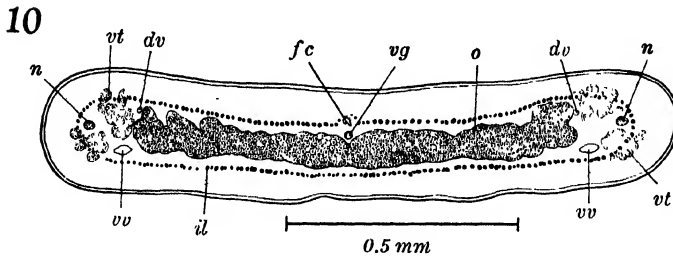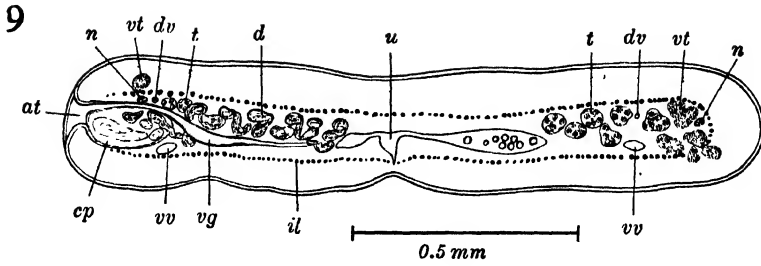
25. Polyclads from Amakusa, Southern Japan[1]

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(With 26 Text-figures and Plates XXXVI–XXXVII)

The present paper deals with the polyclads which were mainly obtained by the author in June, 1937, in the neighborhood of the Amakusa Marine Biological Laboratory at Tomioka, Kumamoto Prefecture. Here, I wish to express my cordial thanks to Professor H. Ohshima for the use of the laboratory as well as my sincere gratitude to Mr. Kikutarô Baba for the privilege extended to me during my stay in Tomioka.

The collection includes the following twenty-two species, of which ten appear to be new to science.

Order Polycladida

    Suborder Acotylea

        A. Section Craspedommata

            Family Discocelidae

                1. *Discocelis pusilla* sp. nov.

                2. *Discocelis japonica* Yeri et Kaburaki

            Family Stylochidae

                3. *Kaburakia gloriosa* sp. nov.

            Family Cryptocelidae

                4. *Cryptocelis amakusaensis* Kato

        B. Section Schematommata

            Family Leptoplanidae

                5. *Notoplana humilis* (Stimpson)

                6. *Notoplana delicata* Yeri et Kaburaki

                7. *Notoplana serica* sp. nov.

                8. *Hoploplana ornata* Yeri et Kaburaki

            Family Planoceridae

                9. *Planocera reticulata* (Stimpson)

            Family Diplosolenidae

                10. *Pseudostylochus obscurus* (Stimpson)

                11. *Pseudostylochus meridialis* sp. nov.

        C. Section Emprosthommata

            Family Cestoplanidae

                12. *Cestoplana marina* sp. nov.

    Suborder Cotylea

            Family Pseudoceridae

13. *Pseudoceros atropurpureus* Kato
14. *Pseudoceros tomiokaensis* sp. nov.
15. *Pseudoceros memoralis* sp. nov.
16. *Pseudoceros pius* sp. nov.
Family Eureleptidae
17. *Cycloporus papillosus* (M. Sars)
Family Prosthiostomidae
18. *Prosthiostomum grande* Stimpson
19. *Prosthiostomum auratum* Kato
20. *Prosthiostomum vulgaris* Kato
21. *Prosthiostomum sonorum* sp. nov.
22. *Amakusaplana ohshimai* gen. et sp. nov.

1. *Discocelis pusilla* sp. nov.

(Pl. XXXVI, Figs. 1, 2; Text-figs. 1-3)[1]

Several specimens of this small flatworm were found on *Zostera* in Tomi-oka Bay.

The largest specimen, 10 mm in length by 4.5 mm in width, is somewhat oval in form, having the anterior end more rounded than the posterior. The ground color of the dorsal surface is opaque white, blotched with a number of round, light brown spots which densely occur in the central parts.

There is no tentacle. At the level of the first fourth of the body lies the brain, on either side of which occur tentacular and cerebral groups of the eyes. The cerebral eyes are arranged in front of the brain, save for one or two ocelli behind it. The marginal eyes are present along the border of the anterior third of the body. The plicated pharynx occupies one-third the body-
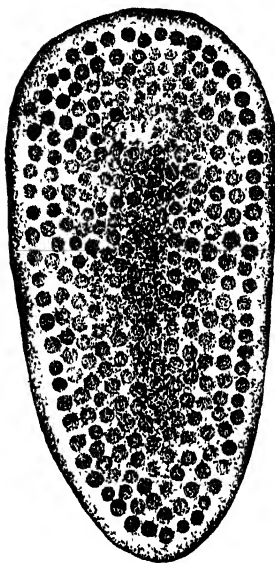
Fig. 1. *Discocelis pusilla.* ×7.   Fig. 2. *Discocelis pusilla;* arrangement of eyes. ×18.
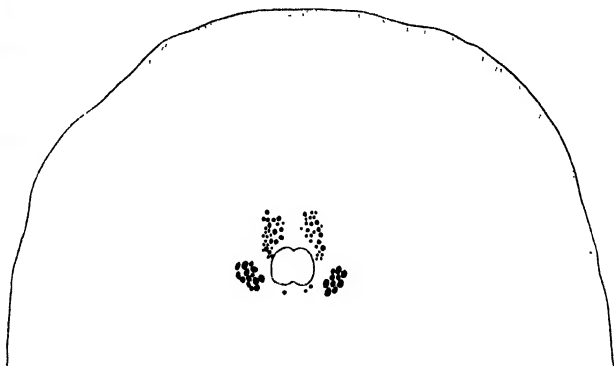
[1] Abbreviations in this and subsequent figures see p. 575.

length, lying in the middle of the body, and the mouth is situated near the posterior end of the pharynx as in *Discocelis japonica* (Kato, 1937 a).

A common genital pore is placed at the anterior limit of the last third of the body and leads into a widely flat common genital atrium, into which open an ejaculatory duct and a vagina. As in *japonica*, many muscular villus-like projections are vertically disposed in the atrium. The prostate glands which are still in a rudimental condition, are distributed in a small number over the external surface of the projections. The ejaculatory duct proceeds anteriad for some distance and is divided into two seminal canals. The vaginal opening occurs in the postero-ventral side of the atrium in the median line, while in both *japonica* and *tigrina* (Lang, 1884) it opens near the common genital pore. The vagina runs first ventrad and then proceeds backward for a long distance to receive a common uterine duct. In my specimens, the Lang's glandular vesicle is not fully developed and merely represented by a large mass of nuclei. The shell secretion is not yet formed.
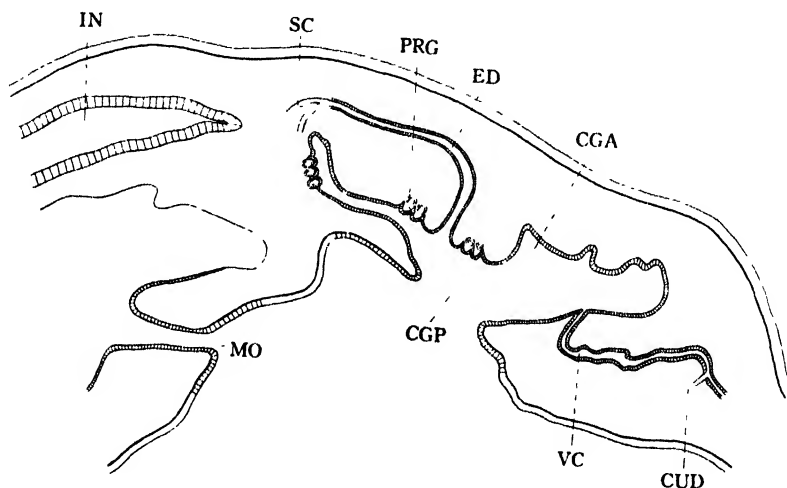
Fig. 3. *Discocelis pusilla;* sagittal section through genital organs. ×70.

The genus *Discocelis* contains four valid species: *D. tigrina, lichenoides* from the Mediterranean Sea, *herdmani* from Ceylon and *japonica*. *D. herdmani* is characterized by the presence of separate genital pores, and *lichenoides* by its milky white color. This species, though presenting some resemblance to *tigrina* and *japonica*, is readily distinguished from them by the small size of the body, the arrangement of the cerebral eyes as well as the position of the vaginal opening.

2. *Discocelis japonica* Yeri et Kaburaki

Discocelis japonica Yeri et Kaburaki, 1918, pp. 3–5; Kato, 1937 a, pp. 212–213.

Two specimens were collected at Siroiwa-zaki.

3. *Kaburakia gloriosa* sp. nov.

(Pl. XXXVI, Figs. 7, 8; Text-figs. 4-6)

A single specimen of this interesting Stylochid was collected by Mr. Baba under a stone at Oniike near Tomioka in spring of 1937.

Fig. 4. *Kaburakia gloriosa.* × 2.

Fig. 5. *Kaburakia gloriosa;* tentacular eyes. × 55.

The oval body measures 34 mm long by 22 mm broad, of a very firm consistency and is uniformly brown in color.

At the level of the first seventh of the body lie a pair of conical tentacles which are retractile within deep sheaths. In the tentacle as well as at its base are found a large number of tentacular ocelli. Numerous cerebral eyes are arranged in two elongated clusters on either side of the mid line. Along the whole body margin are many irregular rows of marginal eyes which are more densely set in the anterior body-half.

The dorsal epidermis is twice as thick as the ventral one and is crowded with an eosinophilous granular secretion. I can find no trace of rhabdites. The dermal musculature is well developed. The dorsal side consists of a thin, outer circular layer, followed by a thick longitudinal and a diagonal layer, and an innermost strongly developed circular layer; the ventral side is composed of a thin, outer circular layer, next to a diagonal, followed by a circular layer and an innermost longitudinal layer. The dorso-ventral muscle fibers are also well developed.

The pharynx is very narrow and long as diagrammatically shown in Fig. 4, and excessively folded. The mouth opening lies near the center of the body.

Near the posterior end of the body there is a large, flatly conical process on the ventral side, inside this process lie the main parts of the reproductive organs. The seminal canals, running posteriorly on either side of the pharyngeal chamber, converge to the process mentioned above, where, they expand each into a long, tubular false seminal vesicle with a thick muscular wall. The seminal vesicle proceeds dorsad and suddenly turns medio-ventrally, and unites with the duct from the other side to make a single
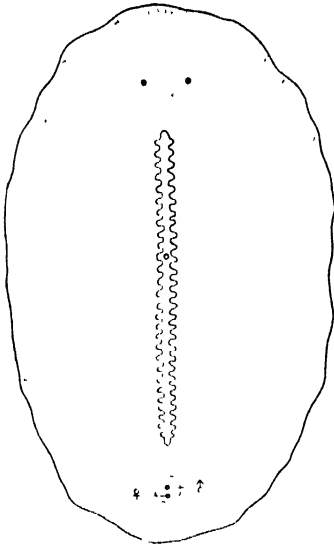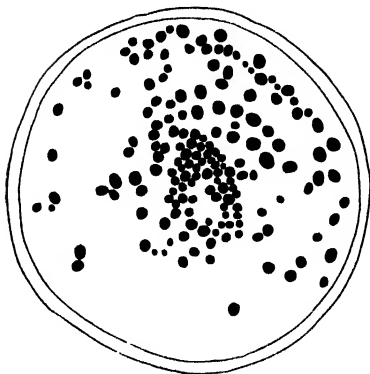
ejaculatory duct which is also coated with a thick muscular wall. It runs posteriad for a short distance along the ventral side and joins with the duct of the prostate vesicle to open at the tip of the penis. The prostate vesicle of this species resembles well that of the members of *Stylochus*. It is a large, elongate oval body with a thick muscular coating and is lined with a richly folded epithelium which forms a large number of radial chambers arranged rather irregularly. The extracapsular prostate glands are well developed. The penis is very small and lacks a chitinous stylet. The antrum masculinum is amply wide and opens to the exterior by a minute pore.
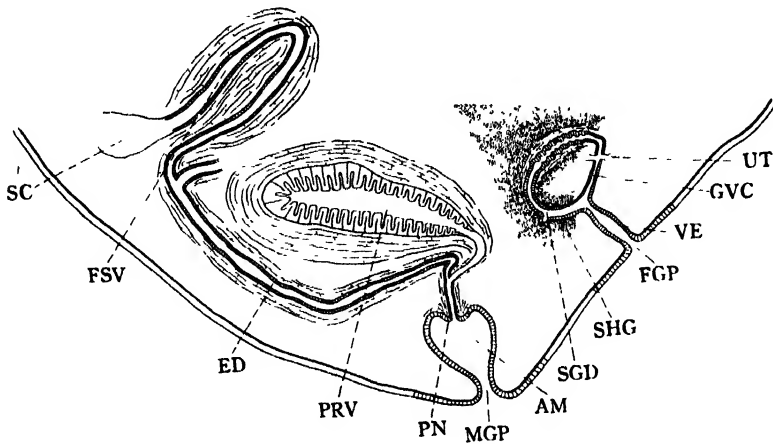
Fig. 6. *Kaburakia gloriosa*; sagittal section through genital organs. ×35.

A short distance posterior to the male genital pore is situated the female orifice which upwardly leads into a cylindrical vagina externa. The latter soon bifurcates into two canals; the one directed anteriad is the shell gland duct and the other directed posteriad is the genito-vaginal canal. The shell gland duct, taking posteriorly a semi-circular course, leads into the vagina interna which, after receiving paired uteri, instead of a single common uterine duct, continues to the genito-vaginal canal given above. The epithelium of the terminal portion of the shell gland duct assumes a spiral arrangement. The shell gland is strongly developed.

The present worm is somewhat related to *Cryptophallus* in the presence of the genito-vaginal canal which opens to the vagina externa itself. However, judging from the possession of distinct tentacles and a horizontally situated, large-chambered prostate vesicle, I consider it is to be referable to *Kaburakia* which has been represented by a single species *excelsa* (Bock, 1925) from the coast of North America. In *excelsa*, the genito-vaginal canal opens to the exterior slightly behind the female genital aperture. This interesting Stylochid seems to be an intermediate form between *Kaburakia* and *Cryptophallus*.

4. *Cryptocelis amakusaensis* Kato

Cryptocelis amakusaensis Kato, 1936, pp. 17–20.

This species is very common on a muddy beach in the vicinity of the laboratory and attacks the living periwinkle, *Umbonium moniliferum*.

5. *Notoplana humilis* (Stimpson)

Leptoplana humilis Stimpson, 1857, p. 9.
Notoplana humilis (Stimpson) Yeri et Kaburaki, 1918, pp. 11–13.
Very common in this district.

6. *Notoplana delicata* Yeri et Kaburaki

Notoplana delicata Yeri et Kaburaki, 1918, pp. 13–15.
This species is also fairly common.

7. *Notoplana serica* sp. nov.
(Pl. XXXVII, Figs. 1–3; Text-figs. 7, 8)

This species is based on a single specimen found adhering to the underside of a stone near the low tidemark at Siroiwa-zaki.

The animal is of an elongated shape with a broadly rounded anterior end and a bluntly pointed posterior extremity, measuring 22 mm in length and 6 mm in breadth. The color of the dorsal surface is translucent white with a large number of minute light brown pigments. Numerous ovaries are seen as white dots in the living state.
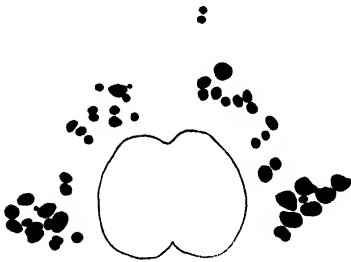
Fig. 7. *Notoplana serica*; arrangement of eyes. ×55.

No tentacle is observed, but the tentacular groups of eyes are present on either side of a large brain at the hind level of the first seventh of the body. Both the tentacular and cerebral eyes, as shown in Fig. 7, are very small in number. The mouth holds a position at the posterior limit of the first third of the body and the plicated pharynx occupies one-fifth the body-length.

The male and the female genital pore are closely applied, lying near the center of the body. The seminal vesicle is ovoid in shape with a thick muscular wall and receives a pair of the seminal canals from ventrad. Issuing from the postero-dorsal corner of the vesicle, the ejaculatory duct soon merges into the prostate vesicle to pierce it in its lower part. The prostate vesicle is also an oval body with a muscular coating, consisting of a few glandular sacks and opens into the ejaculatory duct at the outset of the prostate vesicle. It is abundantly supplied with extracapsular glands. The penis is represented

by a long chitinous stylet which is disposed in a curved state in the deeply narrow antrum.
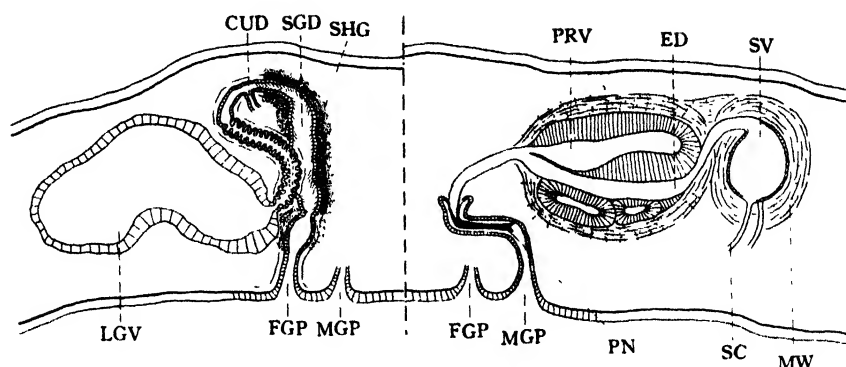
Fig. 8. *Notoplana serica;* sagittal section through genital organs. ×55.

The female genital pore lies directly behind the male pore and leads upwardly into the vagina externa. The dorsal portion of the vagina externa is a little enlarged to form a pouch, into which is discharged a faintly eosinophilous fine secretion carried from the glands scattered in the parenchyma around the pouch. The shell gland duct runs dorso-laterally to near the dermal musculature and passes into a short vagina interna which receives on its ventral side the common duct from the two uteri, and continues to the moniliform duct of the Lang's glandular vesicle. The Lang's vesicle is very large and is situated closely behind the level of the female pore. The shell gland duct is lined with a conspicuously ciliated epithelium and receives a large quantity of spindle-shaped secretion granules of the shell gland.

The present animal is easily distinguished from all other species of this genus by the unique structure and arrangement of the reproductive organs.

8. *Hoploplana ornata* Yeri et Kaburaki

Hoploplana ornata Yeri et Kaburaki, 1918, pp. 15–17 ; Bock, 1924, p. 22.
This splendid *Hoploplana* is commonly found on the undersurface of stones between the tidemarks at Zuirin-ji.

9. *Planocera reticulata* (Stimpson)

Planocera reticulata (Stimpson) Yeri et Kaburaki, 1918, pp. 19–22.
This species is very common in this district.

10. *Pseudostylochus obscurus* (Stimpson)

Stylochus obscurus Stimpson, 1857, p. 11.
Pseudostylochus obscurus (Stimpson) Yeri et Kaburaki, 1918, pp. 30–31.
Numerous specimens were collected at Oniike.

11. *Pseudostylochus meridialis* sp. nov.

(Pl. XXXVI, Figs. 3, 4; Text-figs. 9, 10)

Two specimens were collected under stones in a muddy beach near Zuirin-ji.

This elonagted Pseudostylochid somewhat resembles *Pseudostylochus elongatus* (Kato, 1937 a) in its body shape as well as its color markings, viz., the ground color of the dorsal surface is translucent milky white, over which are scattered yellowish brown spots and darker along the median line. It measures 22 mm in length and 6 mm in breadth.

At the level of the first fifth of the body lie the tentacles which are represented by slight elevations of the epidermis. The arrangement of the eyes is shown in Fig. 9. The mouth is situated at the posterior border of the fourth-ninth from the anterior end and opens into the plicated pharynx which is about one-fifth the body-length.

Immediately behind the posterior end of the pharyngeal chamber, the seminal canals unite into a single duct which is expanded very much with a large mass of spermatozoa. This widened duct opens antero-dorsally into the seminal vesicle by a narrow canal. The vesicle is large, provided with a thick muscular wall and tapers posteriad to form a narrow ejaculatory duct, which pursues a backward course in close contact with
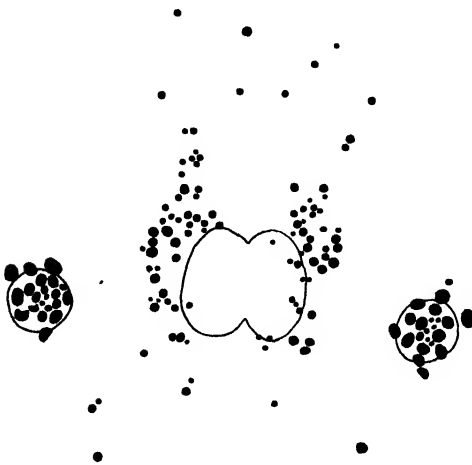
Fig. 9. *Pseudostylochus meridialis;* arrangement of eyes. ×50.
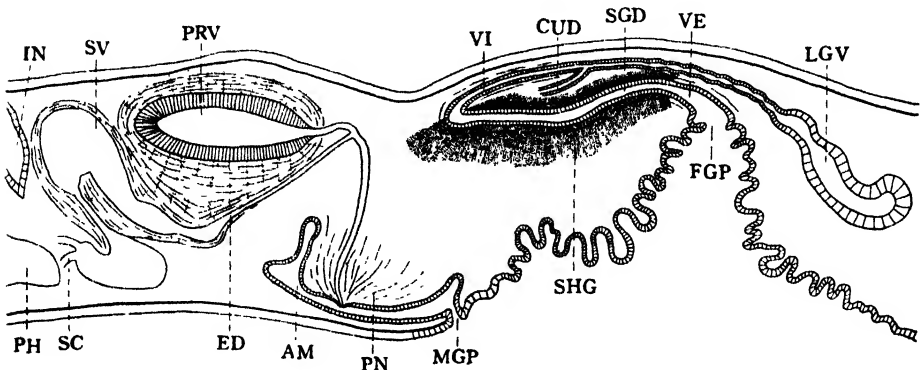
Fig. 10. *Pseudostylochus meridialis;* sagittal section through genital organs. ×50.

the ventral muscular wall of the prostate vesicle to join with its duct. The prostate vesicle is a relatively large, ovoid body and is not divided into chambers. Its muscular wall is well developed, especially more powerful on the ventral side than the dorsal. The penis, resembling that of *P. okudai* (Kato, 1937 b), is a large and flatly conical one. The male gonopore occurs near the posterior end of the antrum and at the anterior limit of the fourth-ninth of the body from the posterior end.

The arrangement of the female genital organs is quite in accord with that of *okudai* and *maculatus*. The sucking structure is well developed around the female aperture. The Lang's glandular vesicle is moderately large.

Of eleven species of *Pseudostylochus*, this flatworm somewhat resembles *P. elongatus*, *okudai* and *maculatus*. It is, however, easily distinguished from *elongatus* by the structure of the reproductive organs, and from the other two species by the body shape as well as the structure of the prostate vesicle and the penis.

12. *Cestoplana marina* sp. nov.
(Pl. XXXVII, Figs. 6–8; Text-figs. 11, 12)

A single representative of this species was taken under a stone at the low tidemark at Ebisu-zaki.

The living animal is of an elongated band-like shape with a bluntly pointed anterior end, measuring 70 mm in length. The posterior body-half is highly contracted in a resting state. The body color is an opaque white without markings as in *Cestoplana lactea* (Kato, 1937 a).

Numerous eye-spots are distributed all over the head, in front of the level of the brain. Among the eye-spots, those arranged from either side of the brain toward anteriad are smaller in size than the others and apparently represent the cerebral groups. The mouth is situated near the posterior end of the short plicated pharynx which lies, as usual, near the hind end of the body.
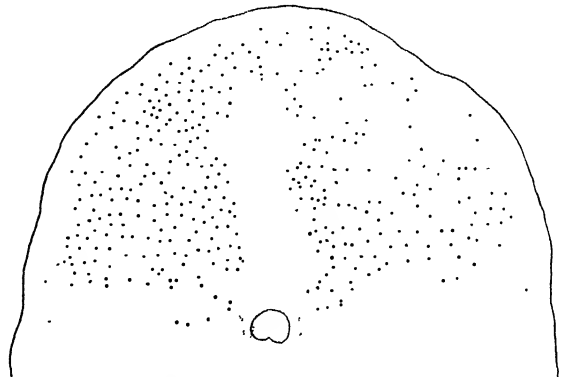
Fig. 11. *Cestoplana marina*; arrangement of eyes. ×22.

The structure of the male and female genital organs resembles well that of *lactea* as shown in Fig. 12. The present planarian, however, is provided with a single male genital system, while *lactea* possesses the duplicate male genital organs. Moreover, in this species, the seminal canals unite into a

single duct before entering the seminal vesicle and the sucker is totally lacking
(*cf. lactea*).
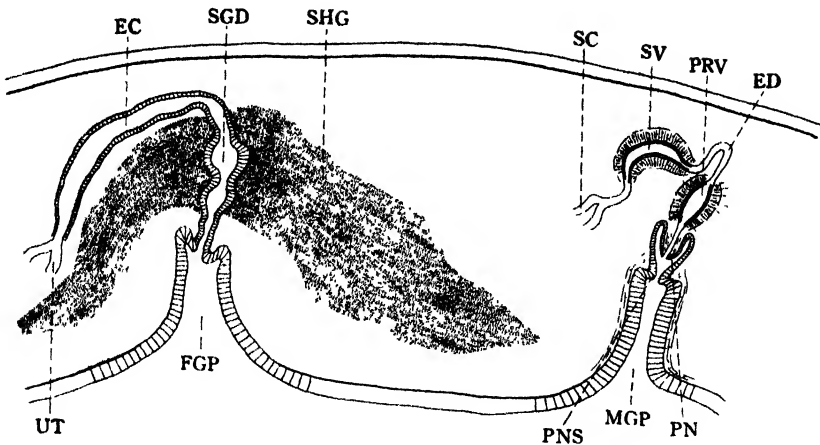
Fig. 12.   *Cestoplana marina;* sagittal section through genital organs. × 70.

13.   *Pseudoceros atropurpureus* Kato

Pseudoceros atropurpureus Kato, 1934, pp. 129-130.

Several specimens of this species were collected at Oniike. The animal
in this locality is more blackish violet on the dorsal surface, and uniformly
distributed white dots are larger than those of the Susaki form. The seminal
canal of the left side does not form a loop in front of its opening into the
seminal vesicle (*cf.* Kato, 1934, p. 129).
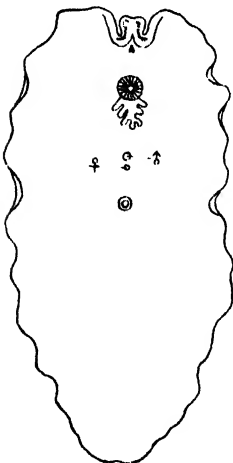
Fig. 13.   *Pseudoceros
tomiokaensis.* ×3.

14.   *Pseudoceros tomiokaensis* sp. nov.

(Pl. XXXVII, Fig. 9; Text-figs. 13–15)

Two individuals of this species were found in the
preserved specimens of the laboratory. They were
collected on *Gelidium* in Tomioka Bay on July 2,
1933.

The body is elongate oval in shape, the anterior
end being broader than the posterior and with a very
frilled margin. It measures 20 mm long by 13 mm
broad. The color is almost gone.

The anterior end of the body is deeply folded
to form a pair of marginal tentacles. A large number
of eye-spots are arranged in regular rows along the
margin of the tentacular folds, and a cluster of cere-
bral eyes lies at the base of the folds. The mouth
is situated at the hind end of the first fifth of the

body. The pharynx is comparatively short, bearing glove-shaped folds. The intestinal branches make a network. The sucker lies a little in front of the middle of the body.

The female genital organs are not yet developed. The male organs are quite similar to the general plan of this genus as shown in Fig. 15. The male pore occurs slightly in front of the posterior end of the first third of the body and the

Fig. 14. *Pseudoceros tomiokaensis;* arrangement of eyes ×22.

female pore a little behind the male one. This species is characterized by the conspicuous arrangement of the eyes.
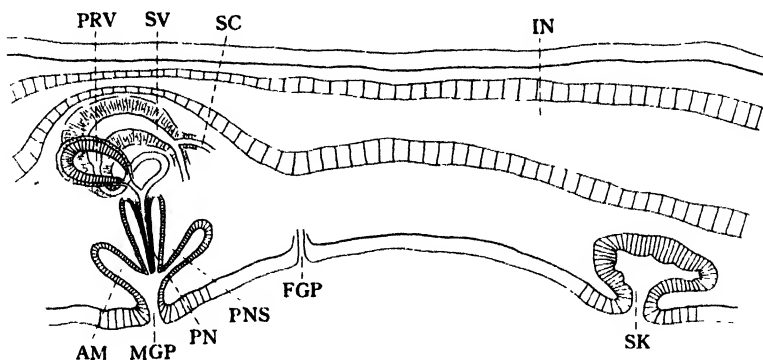
Fig. 15. *Pseudoceros tomiokaensis;* sagittal section through genital organs. ×35.

15. *Pseudoceros memoralis* sp. nov.

(Text-figs. 16–18)

This new *Pseudoceros* is represented by two individuals living on the undersurface of stones below the medium tidemark at Tusi-jima.

The body is oval in shape with a frilled margin, of a delicate consistency, and measures about 30 mm long by 20 mm broad. The dorsal surface is of a fleshy white color with a number of minute dark dots, and is margined all around by three bands of different colors, an outer narrow emerald green, a middle wide black and an inner wide yellowish brown. The two inner bands are numerously interrupted by narrow milky white lines.
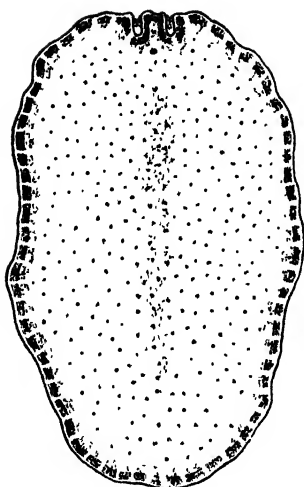
Fig. 16. *Pseudoceros memoralis*. ×2.
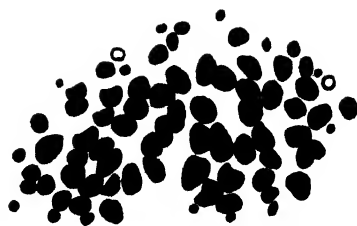
Fig. 17. *Pseudoceros memoralis;* cerebral eyes. ×55.

The frontal margin gives rise to a couple of tentacular folds. The cerebral eyes are vaguely separated into two lateral halves by the median line. A pair of ventral eyes are present. The intestinal and the genital system of this species are closely similar to those found in other species of the genus. The sucker occurs near the middle of the body, and the male and female genital pores lie, as usual, between the sucker and the posterior end of the pharynx.

This species can be distinguished from the known members of the genus by its conspicuous color markings.
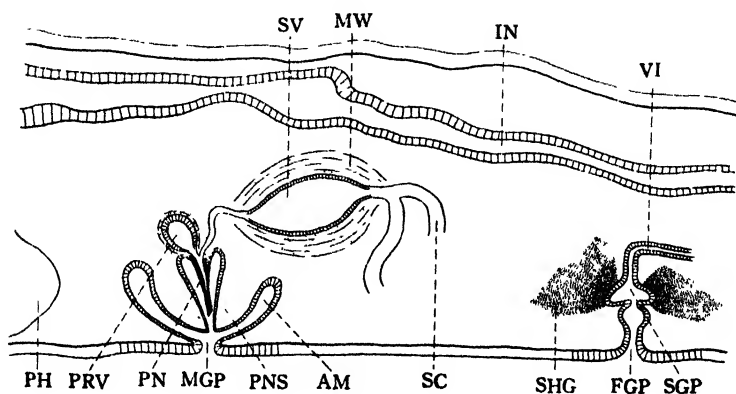
Fig. 18. *Pseudoceros memoralis;* sagittal section through genital organs. ×55.

16. *Pseudoceros pius* sp. nov.

(Text-figs. 19–21)

This new species is based on a single specimen collected at Siroiwa-zaki. The body is thin leaf-like in shape and of a sinuous outline. The tentacles appear as two short folds of the frontal margin of the body. The fully expanded animal measures 15 mm in length and 9 mm in breadth. The dorsal

surface is light yellow, covered with a dense reticulation of minute red and blackish purple pigment granules, and is darker along the median line. In addition, many large blackish purple spots are uniformly distributed over the reticulation. Numerous eye-spots are scattered over each tentacular fold, and the tentacular group of eyes, divisible into two closely approximated clusters, occur dorsad to the brain. The mouth lying, as usual, immediately behind
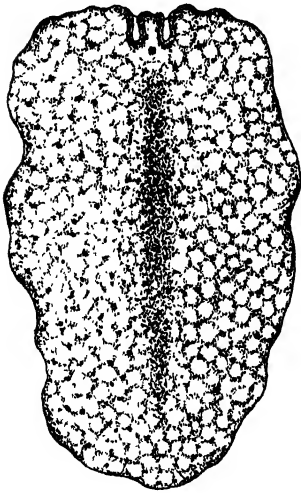
Fig. 19. *Pseudoceros pius.* ×4.

Fig. 21. *Pseudoceros pius;* sagittal section through genital organs. ×55.
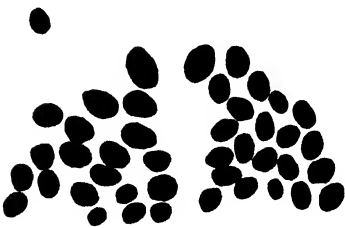
Fig. 20. *Pseudoceros pius;* cerebral eyes. ×55.

the cerebral eyes, leads into a short plicated pharynx. The sucker is nearly in the center of the body.

The genital organs are the common *Pseudoceros*-type, but they take a characteristic arrangement as shown in Fig. 21. The seminal vesicle is very large and is surrounded with a thin muscular wall. The male and the female gonopore, slightly apart from each other, lie at the level directly behind the posterior end of the pharynx.

17. *Cycloporus papillosus* (M. Sars)

Cycloporus papillosus Lang, 1884, pp. 568–571.

Cycloporus papillosus (M. Sars) Bock, 1913, pp. 262–264; Yeri et Kaburaki, 1918, pp. 40–41; Kato, 1937 a, pp. 229–230.

Two specimens of *C. papillosus* var. *misakiensis* were obtained at Siroiwazaki.

18. *Prosthiostomum grande* Stimpson

Prosthiostomum grande Stimpson, 1857, p. 10; Yeri et Kaburaki, 1918, pp. 42–43.

Two specimens were collected at Oniike.

19. *Prosthiostomum auratum* Kato

Prosthiostomum auratum Kato, 1937 d, pp. 363–364.

A single specimen referable to this species was found at Zuirin-ji.

20. *Prosthiostomum vulgaris* Kato

Prosthiostomum vulgaris Kato, 1938 pp. 588.

This widely distributed *Prosthiostomum* was also collected in Tomioka.

21. *Prosthiostomum sonorum* sp. nov.
(Pl. XXXVI, Figs. 5, 6; Text-figs. 22, 23)

A single specimen of this species was collected by the dredge along with some corals from a depth of 10 fathoms off Tomoe-zaki.

The body is of a typical Prosthiostomid-type, measuring 20 mm long by 2 mm broad. The color of the dorsal surface is translucent white covered with brown mottles, a number of which aggregate along the median line to
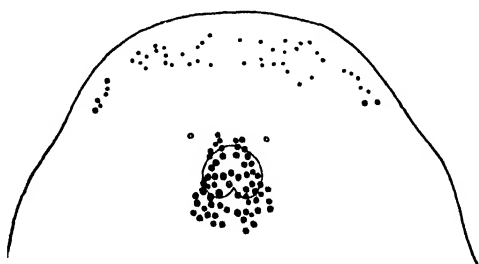
Fig. 22. *Prosthiostomum sonorum*; arrangement of eyes. ×20.

form a brown stripe. The cerebral group of eyes, consisting of about 40 ocelli with a pair of ventral eyes, take a specific arrangement as shown in Fig. 22. They are indistinctly separated into two clusters by the median line. The marginal eyes occur irregularly along the frontal border and a few of them lying in the lateral parts, are larger in size than the others. The mouth lies immediately behind the brain, and leads into a long cylindrical pharynx. The anterior median branch of the intestine runs over the pharynx toward the cerebral region. The sucker is situated nearly in the middle of the body.
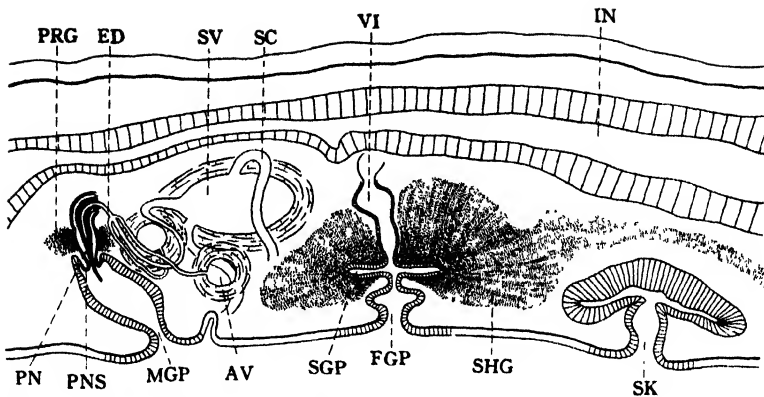
Fig. 23. *Prosthiostomum sonorum* ; sagittal section through genital organs. × 55.

The male genital aperture is situated directly behind the posterior end of the pharynx and at the hind level of the second fifth of the body from the anterior extremity. The female gonopore lies a little posterior to the male pore. The reproductive organs of this animal are in the same plan as in other species of this genus.

22. *Amakusaplana ohshimai* gen. et sp. nov.

(Pl. XXXVII, Figs. 4, 5; Text-figs. 24–26)

Two individuals which seem to represent a new genus and species were taken on Madreporarians at Magari-zaki.

The animal in life is elonagated oval in form, the anterior end being slightly broader than the posterior. The frontal margin of the body is a little depressed in the median line as in *Acerotisa baeckstroemi* (Bock, 1923). The body is very thin, of a delicate consistency and measures 15 mm in length by 6.5 mm in breadth. The dorsal surface is milky white and the intestine is light brownish red. A small brain lies at the first tenth of the body, and immediately behind it, the mouth leads into a short, cylindrical pharynx. The main intestine runs along the median line and bears numerous lateral branches, which do not show any anastomoses. A median branch of the intestine runs anteriorly over the pharynx.

The eye-spots are scattered in the frontal end of the body, chiefly in front of the level
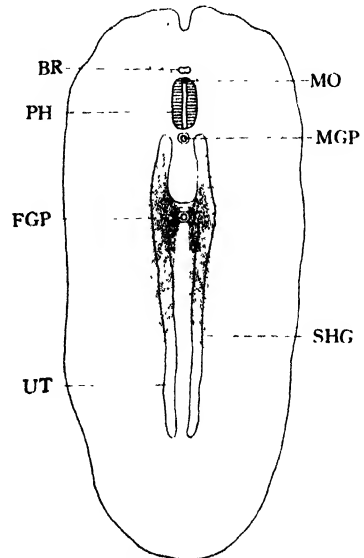
Fig. 24. *Amakusaplana ohshimai*. × 5.

of the brain, and some occur on either side of the anterior half of the pharynx. It is hardly possible to distinguish the eye-spots into the marginal, cerebral and frontal groups.

So far as my observation goes, the present species appears to be devoid of any ventral sucking disc.
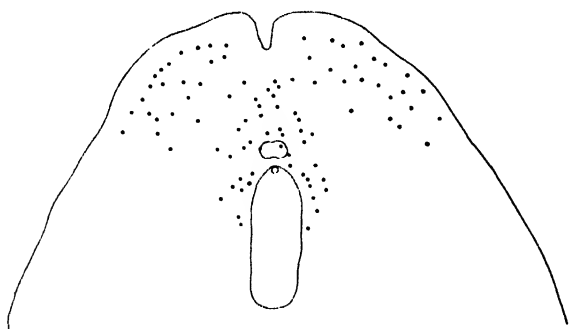
Fig. 25. *Amakusaplana ohshimai;* arrangement of eyes. ×18.

The epidermis, consisting of columnar cells, is higher on the dorsal than on the ventral side. The rhabdites abundantly occur in the dorsal epidermis and very scarce in the ventral one. The dermal musculature is poorly developed.

The general plan of the genital system is quite in accord with that of *Prosthiostomum* as shown in Fig. 26. The small seminal vesicle is coated with a strongly developed muscular wall. A pair of the seminal canals make each its way into the vesicle at its anterior aspects. From the antero-dorsal part of the vesicle is issued an ejaculatory duct, full of sperms, which extends for a long distance to open at the tip of the pointed penial stylet. The paired accessory vesicles open by each narrow canal into the ejaculatory duct some way before entering the penis. A large amount of prostatic secretion empties into the lower half of the penis sheath. The antrum masculinum is wide and deep, opening to the exterior immediately behind the pharynx and a little posterior to the hind limit of the first fifth of the body.
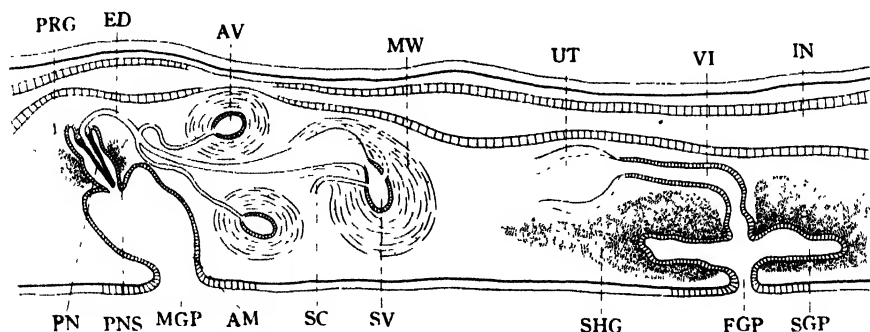
Fig. 26. *Amakusaplana ohshimai;* sagittal section through genital organs. ×50.

The female genital pore is widely separated from the male one. The shell gland pouch is flat and large. The egg canal turns anteriad to receive

two uteri, each of which soon bifurcates into an anterior and a posterior branch. The shell gland secretion is of a spindle shape.

Judging from the features given above, this polyclad, in spite of the total destitute of the sucker, without doubt belongs to the cotylean family Prosthiostomidae, in which are included three genus, *Prosthiostomum*, *Euprosthiostomum* and *Enchiridium*. The species in question is fundamentally different from the members of those genus in the body shape and the arrangement of the eyes. I wish, here, to erect for this worm a new genus *Amakusaplana* under the following diagnosis.

"Prosthiostomid with a thin, elongate oval body, with a slight median depression at the frontal end. The eyes are irregularly scattered in the anterior end of the body, not forming such special groups as the cerebral, marginal or frontal ones. The mouth lies immediately behind the brain. The pharynx is cylindrical and short. Intestinal branches are not anastomosed. Without a sucker ".

By the way, such cotyleans as *Diplopharyngeata filiformis* (Plehn, 1896) and *Simpliciplana marginata* (Kaburaki, 1923) have been reported to be devoid of the sucker.

I take pleasure in naming this species in honor of Professor H. Ohshima.

LITERATURE

List of literature cited is appended to the subsequent paper.

EXPLANATION OF PALTES

ABBREVIATIONS

AM antrum masculinum; AV accessory vesicle; BR brain; CGA common genital atrium; CGP common genital pore; CUD common uterine duct; ED ejaculatory duct; FGP female genital pore; FSV false seminal vesicle; GVC genito-vaginal canal; IN intestine; LGV Lang's glandular vesicle; MGP male genital pore; MO mouth; MW muscular wall; PH pharynx; PN penis; PNS penis sheath; PRG prostate gland; PRV prostate vesicle; SC seminal canal; SGD shell gland duct; SGP shell gland pouch; SHG shell gland; SK sucker; SV seminal vesicle; UT uterus; VE vagina externa; VC vaginal canal; VI vagina interna; ♂ male genital pore; ♀ female genital pore

PLATE XXXVI

1. *Discocelis pusilla* sp. nov., eye-spots. ×40
2. Ditto, sagittal section through genital organs. ×57
3. *Pseudostylochus meridialis* sp. nov., anterior end of body. ×15
4. Ditto, sagittal section through genital organs. ×12
5. *Prosthiostomum sonorum* sp. nov., anterior end of body. ×15
6. Ditto, sagittal section through genital organs. ×40
7, 8. *Kaburakia gloriosa* sp. nov., sagittal section through genital organs. ×12

Plate XXXVII

1. *Notoplana serica* sp. nov., anterior end of body. ×26
2, 3. Ditto, sagittal section through genital organs. ×40
4. *Amakusaplana ohshimai* gen. et sp. nov., anterior end of body. ×26
5. Ditto, sagittal section through genital organs. ×40
6. *Cestoplana marina* sp. nov., anterior end of body. ×26
7, 8. Ditto, sagittal section through genital organs. ×40
9. *Pseudoceros tomiokaensis* sp. nov., anterior end of body. ×26
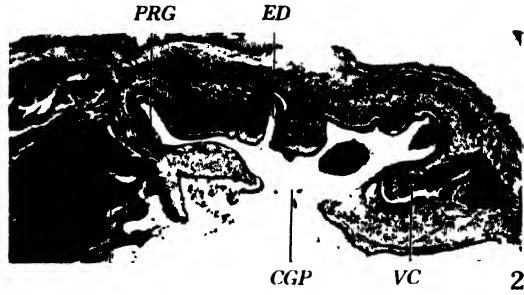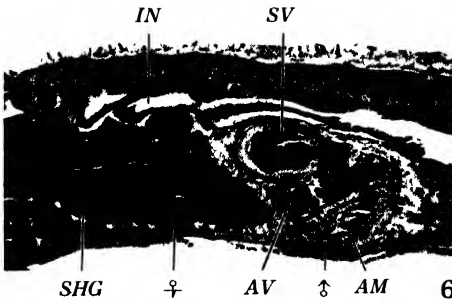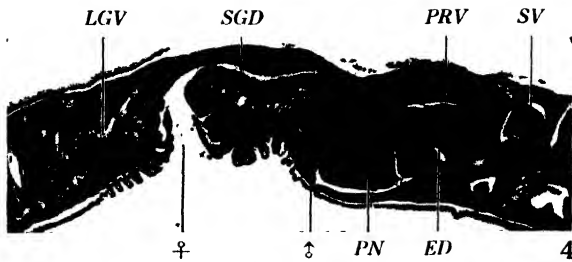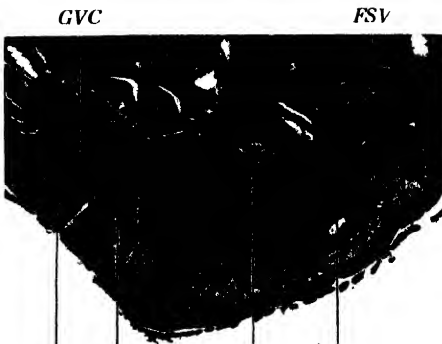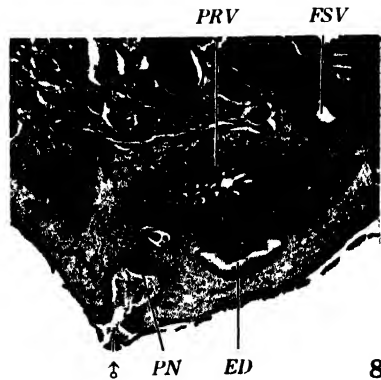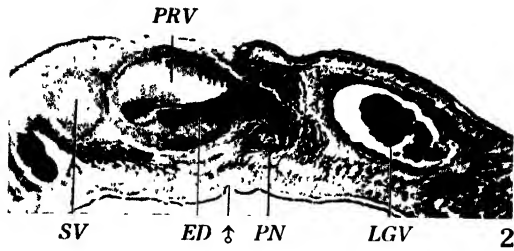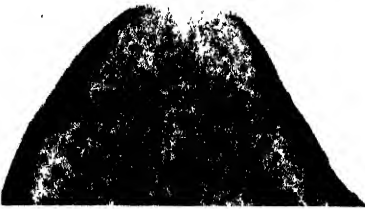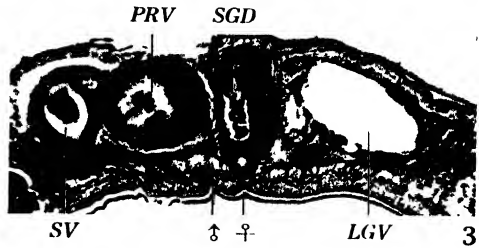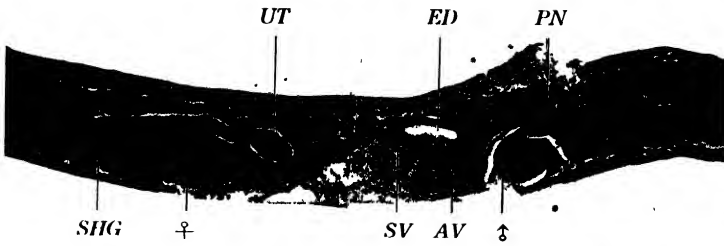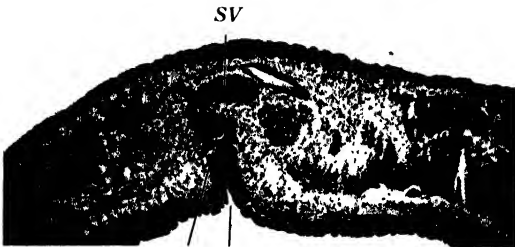
26. Polyclads from Seto, Middle Japan.

By Kojiro Kato

Mitsui Institute of Marine Biology, Susaki near Simoda, Idu

(With 20 Text-figures and Plates XXXVIII–XXXIX)

The polyclads described in this paper were chiefly collected by the author in April, 1937, in the vicinity of the Seto Marine Biological Station at Seto, Wakayama Prefecture. Of the twenty-five species listed below, seven appear to be new.

Order Polycladida
  Suborder Acotylea
     A.   Section Craspedommata
       Family Discocelidae
           1. *Discocelis japonica* Yeri et Kaburaki
       Family Stylochidae
           2. *Stylochus ijimai* Yeri et Kaburaki
           3. *Bergendalia mirabilis* sp. nov.
           4. *Cryptophallus sondaicus* Bock
     B.   Section Schematommata
           5. *Notoplana humilis* (Stimpson)
           6. *Notoplana delicata* Yeri et Kaburaki
           7. *Notoplana japonica* Kato
           8. *Discoplana takewakii* Kato
           9. *Hoploplana cupida* sp. nov.
       Family Planoceridae
          10. *Planocera reticulata* (Stimpson)
       Family Diplosolenidae
          11. *Callioplana marginata* Stimpson
          12. *Pseudostylochus obscurus* (Stimpson)
          13. *Pseudostylochus elongatus* Kato
          14. *Pseudostylochus edurus* sp. nov.
          15. *Pseudostylochus maculatus* sp. nov.
     C.   Section Emprosthommata
          16. *Cestoplana rubrocincta* (Grube)
  Suborder Cotylea
       Family Pseudoceridae
          17. *Pseudoceros atropurpureus* Kato
          18. *Pseudoceros exoptatus* sp. nov.
       Family Eureleptidae
          19. *Cycloporus papillosus* (M. Sars)
       Family Chromoplanidae

20. *Chromoplana bella* Bock
Family Prosthiostomidae
  21. *Prosthiostomum grande* Stimpson
  22. *Prosthiostomum marmoratum* Yeri et Kuburaki
  23. *Prosthiostomum auratum* Kato
  24. *Prosthiostomum valgaris* sp. nov.
  25. *Prosthiostomum laetum* sp. nov.

Before proceeding further, I wish to express my sincere thanks to Prof. Dr. Yô K. Okada, director of the Seto Marine Biological Station, for the use of the laboratory. My deepest thanks are also due to Dr. D. Miyadi and Mr. F. Hiro for their courtesy rendered me during my stay at Seto. Further I wish to thank Dr. G. Dan for correction of the manuscript.

1. *Discocelis japonica* Yeri et Kaburaki

Discocelis japonica Yeri et Kaburaki, 1918, pp. 3–5; Kato, 1937 a, pp. 212–213.
Very common at Edura, Sakatahana, Tôsima and Yuzaki.

2. *Stylochus ijimai* Yeri et Kaburaki

Stylochus ijimai Yeri et Kaburaki, 1918. pp. 6–8.
The most common Stylochid which often attacks young oysters. Numerous specimens were collected at Edura, Daizyasima, Mori and Sakatahana.

3. *Bergendalia mirabilis* sp. nov.
(Figs. 1–3; Pl. XXXVIII, 1, 2.)[1]

This new species is based on a single specimen taken at Yuzaki under a stone slightly embedded in the sand near the low tidemark.

The body is elongated, almost uniformly broad for the most part, with bluntly pointed anterior and posterior extremities, and is moderately firm in consistency, It measures 35 mm long by 6 mm broad in the living state.

The dorsal surface is of a grayish buff-pinkish color with a reddish median streak which fades away toward the margin. The ventral side is paler in color.

Both the tentacles and the tentacular eyes are totally lacking. Numerous eyes are densely disposed in the entire frontal part of the body and the marginal eyes are arranged in rows along the whole margin of the body.

The epidermis is much thicker on the dorsal than on the ventral side and consists of columnar cells containing a large number of spindle-shaped rhabdites and a great quantity of basophilous secretory substance.

The dermal musculature of the dorsal side is composed of a thin circular muscle layer immediately beneath the basement membrane, an outer thick longitudinal, a middle diagonal and an inner circular layer. The ventral side consists of an outer longitudinal, a middle circular and an inner longitudinal

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[1] Abbreviations in this and subsequent figures see p. 592.

layer. The dorso-ventral muscle fibers are poorly developed.

The mouth is somewhat anterior to the center of the body and leads into a pharyngeal chamber with numerous lobed diverticulae. The main intestine running along the median line is provided with numerous lateral branches

Fig. 1. *Bergendalia mirabilis.* ×2.5.
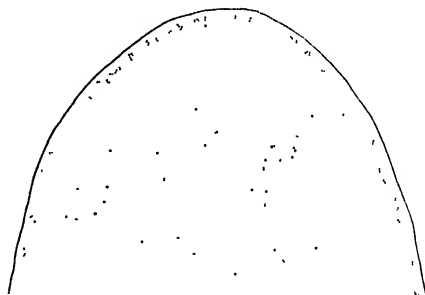
Fig. 2. *Bergendalia mirabilis;* arrangement of eyes. ×8

which repeatedly ramify toward the periphery but do not show any anastomosis. In *Bergendalia diversa* (Yeri et Kaburaki, 1918) the lateral intestinal branches form a network.

The seminal canals, proceeding backward, turn dorso-mediad slightly behind the posterior end of the pharyngeal chamber to enlarge each into a tubular seminal vesicle with a thin muscular wall. The seminal vesicles narrow antero-mediad to unite into a single ejaculatory duct which soon joins, at a right angle, the duct from the prostate. The prostate vesicle is a horizontally situated, moderately large organ lined with cubical cells and is coated with a muscular wall, through which pierce numerous efferent ducts of the extracapsular glands. Arising from the distal end of the prostate, the relatively wide duct runs ventrad and after receiving the ejaculatory duct opens at the tip of the penis. The penis is small, conical and unarmed, vertically disposed in the cylindrical antrum which opens to the exterior by a small pore at the level between the last fourth and the last fifth of the body.

The female genital pore, situated a little behind the male pore, leads upwardly into the vagina externa which passes anteriorly into the shell gland duct. The internal epithelium of the terminal part of this duct assumes a spiral arrangement and into that portion empties a great amount of minutely granular shell secretion. The vagina interna turns posteriad and, receiving the common uterine duct, continues to the genito-vaginal canal which curves down to open to the exterior directly behind the female aperture. Just behind the genito-vaginal pore, two special post-genital glands are arranged in the median line. They are formed by the tubular infoldings of the ventral epidermis

and are lined with cubical cells, receiving the eosinophilous secretion from the extracapsular glands.

Under the genus *Bergendalia* have been recorded two species, *anomala* (Laidlaw, 1903 a) from Penang and *diversa* from Japan. They are characterized by the possession of the duplicate male copulatory organs and are closely
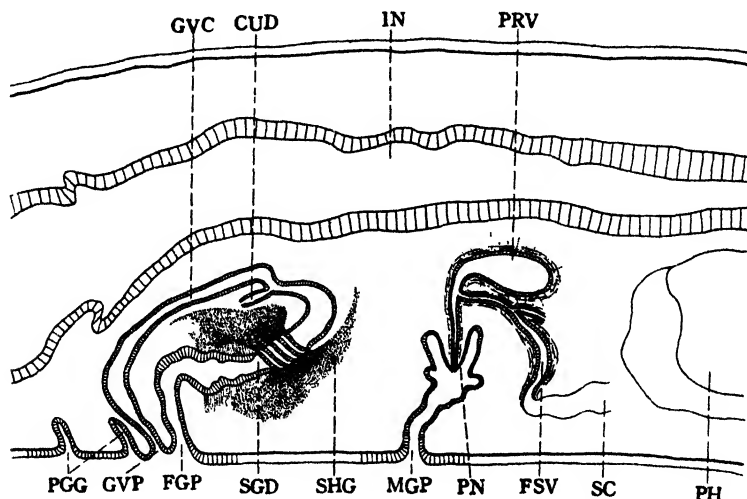
Fig. 3. *Bergendalia mirabilis*; sagittal section through genital organs. ×55.

similar, except for the presence of eyes over the head-end surface and the fact that the duplicate penial organs are situated in front of, instead of behind, the functional penial organs. The present worm bears a certain resemblance to *diversa* in the arrangement of the eyes, but is distinguished from that and the another species by the total absence of the duplicate penial organs. The possession of the post-genital glands is also a characteristic feature of this species.

The generic diagnosis of *Bergendalia* is amended as follows: " Stylochidae with elongate body, without tentacles and tentacular eyes. Marginal eyes are arranged along the whole body margin. With or without additional eyes distributed over the head end. Pharynx long, much folded and the mouth subcentral. With false seminal vesicles. Prostate vesicle is moderately large and horizontally situated. Penis unarmed. With or without duplicate penial system. With genito-vaginal canal which opens to the exterior immediately behind the female genital pore."

4. *Cryptophallus sondaicus* Bock

(Figs. 4-6; Pl. XXXVIII, 3, 4.)

Cryptophallus sondaicus Bock, 1925, pp. 120-132.

In the Museum of the Station was preserved a single specimen of *Cryptophallus* which had been obtained at Edura on Aug. 1, 1928.

The body is elongate oval in form, thick and of a firm consistency. The measurements of the specimen are as follows: The length of the body is 40 mm and the breadth 20 mm. From the tentacular eyes to the anterior end is 9 mm. From the mouth to the posterior end is 12 mm. The female genital pore is 4 mm from the posterior end. The male genital pore is 3.5 mm from the female, and 5 mm from the mouth.
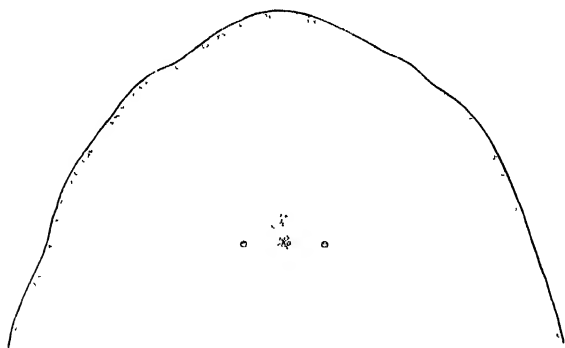
Fig. 4. *Cryptophallus sondaicus;* arrangement of eyes. ×3.5.

Fig. 5. *Cryptophallus sondaicus;* marginal (*a, b*) and tentacular eyes (*c*). ×50. *a.* At the anterior end. *b.* At the posterior end.

The color of the dorsal surface is light silvery black, darker along the median line, and the ventral side is almost colorless. Four or five tentacular ocelli are grouped at the base of the tentacles which are slight elevations of the epidermis. Along the whole margin of the body are arranged in a row the marginal eyes which are considerably larger in size than those of *Cryptophallus eximius* (Kato, 1937 a).

The male genital organs lie beneath the posterior end of the pharynx.
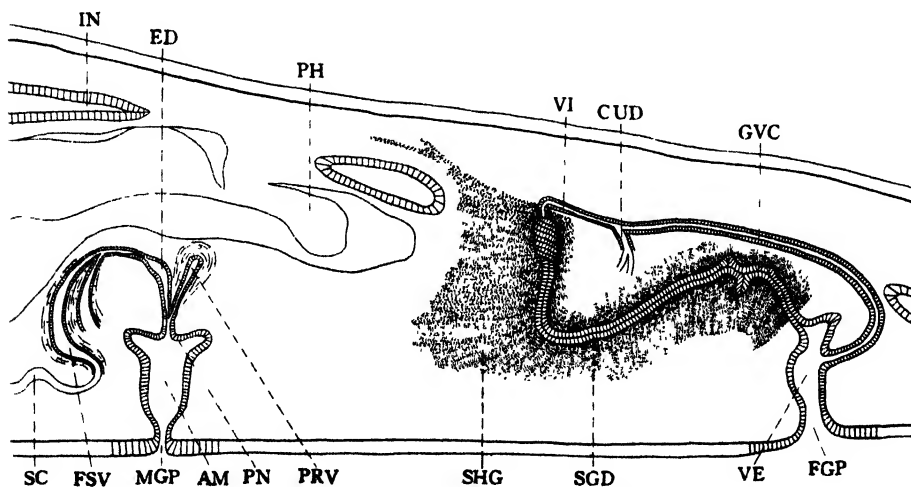
Fig. 6. *Cryptophallus sondaicus;* sagittal section through genital organs. ×30.

They consists of a wide antrum, a small, unarmed penis, a vertically placed, small prostate vesicle and a pair of tubular false seminal vesicles. The arrangement of the female genital organs is much similar to that found in the other species of this genus. The shell gland duct is extremely narrow and a part of the duct has a few twists.

The genus *Cryptophallus* contains three foreign species (*wahlbergi, sondaicus, bartschi*) and one Japanese form (*eximius*). The specimen from Seto is quite in accord with *sondaicus* from Amboina in its external and internal organizations except for the total absence of the rudimentary duct in connection with the ductus vaginalis. In spite of the conclusion of Meixner (1907, p. 144.) "So kommt es, dass nach unsern heutigen Kenntnissen jede Küstenpartie ihre besondere Stylochinen-Formen zu haben scheint.", I prefer to assign the Seto specimen for the present to *C. sondaicus*.

5. *Notoplana humilis* (Stimpson)

Leptoplana humilis Stimpson, 1857, p. 9.
Notoplana humilis (Stimpson) Yeri et Kaburaki, 1918, pp. 11–13.
The most common polyclad in the neighborhood of the Station.

6. *Notoplana delicata* Yeri et Kaburaki

Notoplana delicata Yeri et Kaburaki. 1918, pp. 13-15.
This species is also very common, like *N. humilis*.

7. *Notoplana japonica* Kato

Notoplana joponica Kato, 1937 a, pp. 215-216.
Five specimens referable to *Notoplana japonica* from Idu were collected at Yuzaki. This species is easily distinguished from *N. humilis* by its milky white color with a faint touch of pinkish brown and by the total absence of the tentacles.

8. *Discoplana takewakii* Kato

Discoplana takewakii Kato, 1935, pp. 149–157.
At Sakatahana, *Ophioplocus japonicus* was often found to be harbored in the genital bursa by this interesting planarian.

9. *Hoploplana cupida* sp. nov.
(Figs. 7, 8; Pl. XXXVIII, 5, 6.)

This species is based on a single specimen found at Tunasiradu.
The body is oval in shape with rounded anterior and posterior ends, thick and of a firm consistency, measuring 12 mm by 7 mm. The ground color of

the dorsal surface is milky brown with minute brown speckles scattered all over it. The ventral side is milky white.

A pair of long tentacles are situated at a distance of 3 mm from the frontal end of the body. They are colorless. The tentacular eyes are numerous, grouped at the base of each tentacle. The cerebral eyes are very few in number, arranged on either side of the median line far in front of the level of the tentacles. The mouth is nearly in the center of the body.
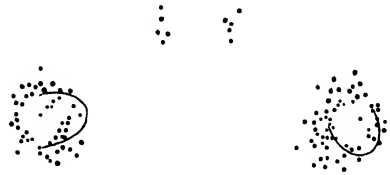
Fig. 7. *Hoploplana cupida*; arrangement of eyes. ×22.

The seminal canals, proceeding backward, expand each into a very large false seminal vesicle with a thin muscular wall. From the distal narrow end of the vesicle is sent off a slender duct which takes a tortuous course, and joins with the duct from the other side to make an ejaculatory duct. After a few turns the ejaculatory duct opens into the prostate vesicle, piercing through its muscular wall. The prostate vesicle is very small, pyriform in shape, provided with numerous extracapsular glands. The anterior end of the prostate tapers, to end in a curved, sharply pointed penial stylet. The antrum masculinum is cylindrical, wide and deep, and opens to the exterior by a minute pore at the anterior limit of the last fourth of the body. Both the antrum and the prostate are enclosed in a thick muscular wall.
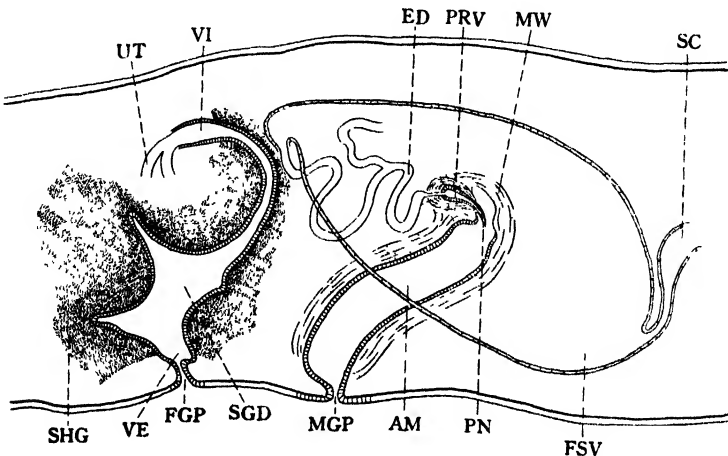
Fig. 8. *Hoploplana cupida*; sagittal section through genital organs. ×50.

The female genital aperture lies slightly behind the male pore. It leads into the ample vaginal cavity which narrows anteriorly and makes a dorsal turn to receive two uteri. Shell glands are enormously developed surrounding nearly the whole length of the vagina.

There have been recorded six species of *Hoploplana*, i. e., *grubei, inquilina*,

insignis, ornata, papillosa and *villosa*.   The present animal is easily distinguished
from them by the topography of the male genital organs.

10. *Planocera reticulata* (Stimpson)

Planocera reticulata (Stimpson), Yeri et Kaburaki, 1918, pp. 19–22.
This species is very common in this district.

11. *Callioplana marginata* Stimpson

Callioplana marginata Stimpson, 1857, p. 11 ; Yeri et Kaburaki, 1918,
pp. 32–34.
This species is found in abundance at Yuzaki and at Tubaki near Seto.

12. *Pseudostylochus obscurus* (Stimpson)

Stylochus obscurus Stimpson, 1857, p. 11.
Pseudostylochus obscurus (Stimpson) Yeri et Kaburaki, 1918, pp. 30–31.
Three specimens of this species were found in the Museum of the Station.
They were obtained at Tôsima on May 4, 1928.

13. *Pseudostylochus edurus* sp. nov.
(Figs. 9, 10; Pl. XXXVIII, 8.)

Two specimens of this species were obtained at Edura.
The body is elongate oval in shape with a rounded anterior and a bluntly
pointed posterior extremity, measuring 20 mm long by 8 mm broad.   The dorsal
surface is covered with brown mottles on the light brownish green background
and is darker along the median line.
A pair of small tentacles are situated at the posterior border of the first
fifth of the body and each contains numerous eye-spots.   The arrangement of
the eyes is shown in Fig. 9.   The mouth
lies at the hind end of the second third
of the body, leading into the pharyngeal
chamber at its middle point.

Fig. 9.   *Pseudostylochus edurus ;*
arrangement of eyes. ×30.

The reproductive organs are of the
typical Pseudostylochid-type.   The seminal
vesicle is moderately large with a thick
muscular wall, lying a little behind the
posterior end of the pharyngeal chamber,
but not directly behind it.   The prostate
vesicle is a large ovoid body with a very
thick muscular wall and consists of a few
tubular glands.   The penis is small, flatly
conical in shape and is subvertically dis-

posed in the antrum masculinum which opens to the exterior at the posterior limit of the third fifth of the body. Surrounding the male genital pore the parenchyma as well as the ͅepidermis are slightly protruded. About 2.5 mm
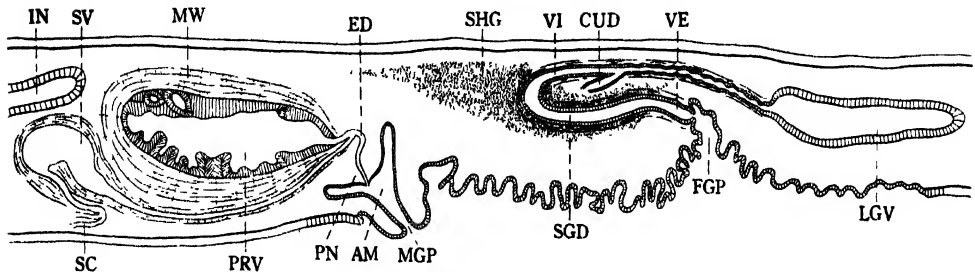
Fig. 10. *Pseudostylochus edurus;* sagittal section through genital organs. ×35

distant from the male pore lies the female aperture, surrounding which the sucking structure is developed as in *P. okudai, stimpsoni* and *aino.* The Lang's glandular vesicle is large and elongated, and the duct from it assumes a bead-like appearance.

In the general structure of the genital organs, this species is closely related to *aino* (Kato, 1937 c) from Hokkaidô. However, it differs from the latter in the possession of the large Lang's vesicle, a small penis and a large prostate vesicle.

15. *Pseudostylochus maculatus* sp. nov.
(Figs. 11, 12; Pl. XXXIX, 7.)

A single specimen of this new planarian was collected at Yuzaki.

The worm, in life, has a lengthened oval body, measuring 35 mm long by 14 mm broad. The dorsal surface is of a grayish green color variegated with dark yellowish- and greenish-brown maculae, and is darker along the the median line.

At the hind limit of the first fourth of the body lie a pair of very small ten-tacles which are slight elevations of the epidermis. The arrangement of the eyes is shown in Fig. 11. The mouth is located near the middle of the body. The pharynx is plicated, occupying three-sevenths the body length. The main intestine sends off about eight pairs of lateral branches.

The seminal canals run anteriad from near the posterior end of the body, turn backward at the level of the middle of

Fig. 11. *Pseudostylochus maculatus;* arrangement of eyes. ×25.

the body and, proceeding postero-mediad, unite into a single duct on the ventral side of the body which abruptly opens into the seminal vesicle. The latter is
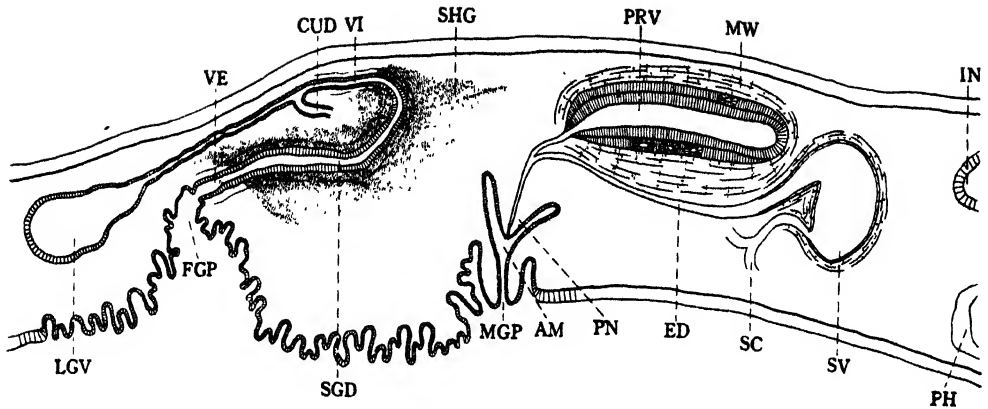
Fig. 12. *Pseudostylochus maculatus;* sagittal section thróugh genital organs. ×30.

a relatively large, ovoid body lined with a flat epithelium and is surrounded with a muscular wall. The postero-dorsal part of the vesicle tapers backward to pass into the ejaculatory duct, which, skirting the ventral side of the prostate vesicle, runs for a long distance to join the duct from the prostate at the base of the penis. The prostate vesicle, placed on the dorsal side of the body, is a large elongate-ovoid body with a thick muscular wall, and its efferent duct, after receiving the ejaculatory duct, opens at the tip of a small conical penis. The penis totally lacks the chitinous stylet and hangs subvertically in the deep antrum which opens to the exterior at the posterior level of the fourth seventh of the body.

The female aperture is a little posterior to the male pore. The structure of the female genital organs is quite in accord with that of other species of this genus. The sucking structure is developed around the female pore.

This species can be distinguished from the known members of the genus by the dorsal position of the prostate vesicle, by the possession of the small conical penis, the small Lang's vesicle and the sucking structure of the female pore.

16. *Cestoplana rubrocincta* (Grube)
(Fig. 13)

Cestoplana rubrocincta (Grube) Lang, 1884, pp. 516–520 ; Kato, 1937 a, pp. 225–226.

Cestoplana filiformis Laidlaw, 1903 b, pp. 110–111.

Cestoplana australis Haswell, 1907, pp. 479–480.

This species is fairly common at Yuzaki and Edura. The largest specimen at my disposal is about 15 mm in length and 2 mm in breadth. The anterior end of the body is rounded as in *C. australis* of Haswell. The constriction found on the head of the Susaki specimen is probably an occasional one (Kato, 1937 a). The ground color of the dorsal surface is milky white with

a faint touch of yellow, with three longitudinal reddish orange striations as shown in Fig. 13.

17. *Pseudoceros atropurpureus* Kato

Pseudoceros atropurpureus Kato, 1934, pp. 129–130.

Very common at Yuzaki. This worm somewhat resembles *Pseudoceros velutinus* in its dark purplish color. The former, however, is easily distinguished from the latter by the presence of numerous minute white dots all over the dorsal surface.

18. *Pseudoceros exoptatus* sp. nov.
(Figs. 14, 15; Pl. XXXIX, 1, 2.)

A number of this species were collected at Sakatahana and Tunasiradu.

The body is oval in shape with a somewhat pointed posterior extremity and is of a delicate consistency. The margin of the body is very frilled. The larger specimens measure about 80 mm long by 40 mm broad. Along the median line the body is thickly elevated.

The color of the dorsal surface is light blackish violet and brownish along the median line, all over which are uniformly dispersed small white mottles. The body margin is of a dark purplish color. The ventral side is milky white.

The marginal tentacles are deep folds of the anterior end of the body and on both the dorsal and ventral sides are scattered numerous eye-spots. At the base of the tentacular folds lies a cluster of cerebral eyes (about 30), which are indistinctly separated into two groups by the median line.

The mouth is located at the hind limit of the first eighth of the body. The main intestine runs along the median line to near the end of the body and is provided with numerous lateral branches which repeatedly ramify toward the periphery to form a network. The sucker is situated at the posterior extremity of the first third of the body. Between the mouth and the sucker occur the male and female genital pores in the middle line.

The seminal canals running anteriad turn dorso-mediad near the level of

Fig. 13. *Cestoplana rubrocincta.* ×7.
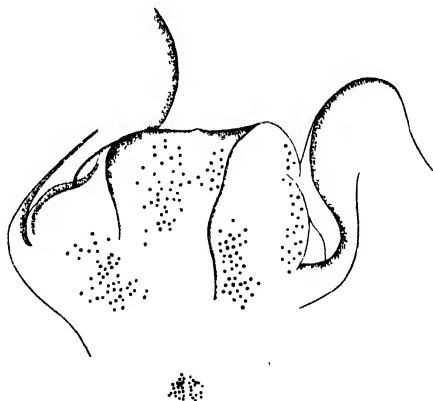
Fig. 14. *Pseudoceros exoptatus;* arrangement of eyes. ×17.
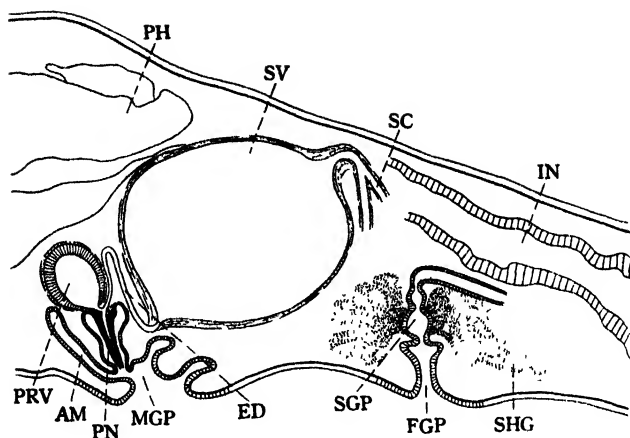
Fig. 15. *Pseudoceros exoptatus*; sagittal section through genital organs. ×17.

the female genital pore and unite into a single duct which opens directly into the large spherical seminal vesicle at its postero-dorsal aspect. From its antero-ventral part the narrow ejaculatory duct goes upward and then downward to open at the tip of the penial stylet. The small, spherical prostate vesicle tapers ventrally and soon makes its way to the ejaculatory duct at the base of the penis which is surrounded by the penis sheath.

A little behind the male genital pore lies the female pore. The antrum femininum passes into the shell gland pouch which continues to the egg canal. The shell gland secretion is abundant.

There have been recorded large numbers of *Pseudoceros* species, but so far as I can determine, my planarian resembles *P. sagamianus* (Kato, 1937 d) more closely than any other. However, it is distinguished from the latter by the structure of the male genital organs.

19. *Cycloporus papillosus* (M. Sars)

Cycloporus papillosus Lang, 1884, pp. 568–571.
Cycloporus papillosus (M. Sars) Bock, 1913, pp. 262–264; Yeri et Kaburaki, 1918, pp. 40–41; Kato, 1937 a, pp. 229–230.

A single specimen referable to *Cycloporus papillosus* var. *misakiensis* was collected under a stone near the low tidemark at Yuzaki.

20. *Chromoplana bella* Bock

(Fig. 16)

Chromoplanaa bella Bock, 1922, pp. 1–20.
Five specimens identical with *Chromoplana bella* from Misaki were collected under stones between the tidemarks at Yuzaki.

The animal is lancet shaped, measuring 8 mm in length. The dorsal surface is of a blackish brown color, provided with three white longitudinal streaks. The cerebral region and the frontal end of the body are also white. The ventral side is light brownish red in color. The marginal and the cerebral group of eyes each consists of two ocelli. A small sucker lies near the center of the body. As pointed out by Bock, the dorsal epidermis contains numerous nematocysts.

21. *Prosthiostomum grande* Stimpson

Prosthiostomum grande Stimpson, 1857, p. 10; Yeri et Kaburaki, 1918, pp. 42–43.

A fairly large number of this species were collected at Sakatahana and Tubaki.
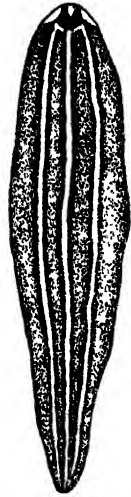
Fig. 16. *Chromoplana bella* ×8.

22. *Prosthiostomum marmoratum* Yeri et Kaburaki

Prosthiostomum marmoratum Yeri et Kaburaki, 1918, pp. 43–44.
Numerous specimens of this species were collected at Yuzaki.

23. *Prosthiostomum auratum* Kato
(Pl. XXXIX, 7.)

Prosthiostomum auratum Kato, 1937 d, pp. 363–364.

Numerous specimens referable to *P. auratum* from Idu were obtained under stones at Yuzaki and Sakatahana. The larger specimens measure 25 mm by 4 mm. This species is often found along with *Prosthiostomum vulgaris*, but is easily distinguished from it by its uniformly yellowish color with no spots or stripes, and by the arrangement of the eyes. In *auratum* the cylindrical pharynx is much shorter than that of *vulgaris*.

24. *Prosthiostomum vulgaris* sp. nov.
(Figs. 17, 18; Pl. XXXIX, 3, 4.)

Numerous specimens of this species were collected at Yuzaki.

The body is very elongate with a rounded anterior end and a pointed posterior extremity, thin and delicate. A large specimen measures 25 mm in length and 3 mm in breadth.

The color of the body is light buffy, nearly cinnamon along the median line. In some specimens, minute white spots are scattered in great number in the median parts.

The cerebral eyes are arranged in two nearly linear groups, with a pair
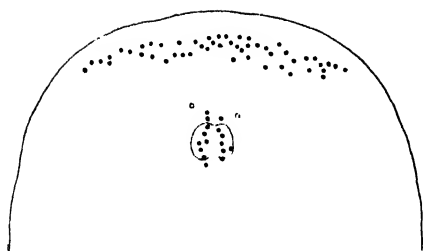
Fig. 17. *Prosthiostomum vulgaris*. arangement of eyes. ×22.

of ventral eyes. The marginal eyes are distributed along the frontal margin in irregular rows. The mouth lies immediately behind the brain and leads into the long cylindrical pharynx. The anterior median branch of the intestine runs for a short distance over the pharynx to end blindly. The sucker is located near the center of the body.
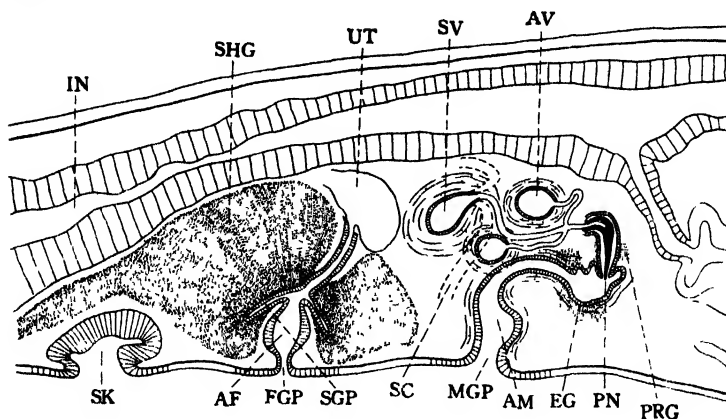
Fig. 18   *Prosthiostomum vulgaris*, sagittal section through genital organs. ×45.

This species is widely distributed along the Pacific coasts of Japan. Yeri and Kuburaki (1918) recorded this worm from Misaki, Matuwa and Sirahama, and referred it to the Mediterranean species *Prosthiostomum siphunculus*. However, after thorough studies on numerous specimens, I consider that this planarian represents a new species. The Japanese species is clearly distinguished from the Mediterranean by the total absence of the anterior median branch of the intestine, and in *vulgaris* the seminal canals open into the seminal vesicle at its anterior part near the ejaculatory duct, but in *siphunculus* the canals open at the posterior corner of the vesicle.

25. *Prosthiostomum laetum* sp. nov.

(Figs. 19, 20; Pl. XXXIX, 5, 6.)

This species is based on a single specimen collected by the dredge-net from a depth of about ten fathoms off Tonda near Seto.

The specimen was devoid of the posterior half of the body. It measures 4 mm from the frontal border of the body to the sucker and about 2 mm across the brain region. The anterior end of the body is slightly pointed. The color of the dorsal surface is light blackish green and the ventral side is paler.

The cerebral eyes, about 30 in number, are divided into two groups by the median line, and a pair of ventral ocelli lie on either side of the brain. The marginal eyes are few, arranged along the anterior end of the body. Almost all the ocelli are crescent or semicircular in shape.

The mouth is located directly beneath the cerebral eyes and leads into the cylindrical pharynx. The anterior median branch of the intestine runs for a short distance to end blindly. The sucker is small.

The reproductive organs of
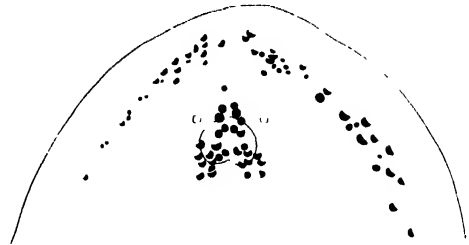
Fig. 19. *Prosthiostomum laetum :* arrangement of eyes × 35.
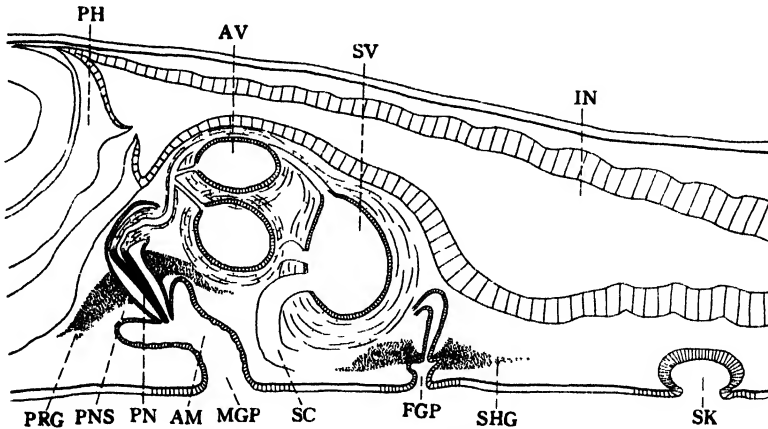
Fig. 20. *Prosthiostomum laetum ;* sagittal section through genital organs. × 35.

this species are quite in accord with the type of the genus. The seminal vesicle is very large, provided with a thick muscular wall. The ejaculatory duct runs along the dorsal side, and after receiving the paired ducts of the accessory vesicles, opens at the tip of the penis. The accessory vesicle is large and spherical, surrounded with a thick muscular wall and containing a mass of eosinophilous secretion granules. The penial stylet is long. A large quantity of prostate gland secretion gathers around the cavity of the penis sheath. The arrangement of the female genital organs is much similar to that found in other species of this genus. The egg canal is directed anteriad.

The present worm differs distinctly from all other members of *Prosthiostomum* in the arrangement of the eyes as shown in Fig. 19, and in some minute points of the male genital organs.

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EXPLANATION OF PLATES

ABBREVIATIONS

AF antrum femininum; AM antrum masculinum; AV accessory vesicle; CUD common uterine duct; ED ejaculatory duct; EG eosinophilous gland; FGP female genital pore; FSV false seminal vesicle; GVC genito-vaginal canal; GVP genito-vaginal pore; IN intestine; LGV Lang's glandular vesicle; MGP male genital pore; MW muscular wall; PGG post genital gland; PH pharynx; PN penis; PNS penis sheath; PRG prostate gland; PRV prostate vesicle; SC seminal canal; SGD shell gland duct; SGP shell gland pouch; SHG shell gland; SK sucker; SV seminal vesicle; UT uterus; VE vagina externa; VI vagina interna; ♂ male genital pore; ♀ female genital pore.

Plate XXXVIII

1, 2. *Bergendalia mirabilis* sp. nov., sagittal section through genital organs. × 40
3. *Cryptophallus sondaicus* Bock, dorsal (left) and ventral (right) views. × 1
4. Ditto, sagittal section through genital organs. × 15.
5, 6. *Hoploplana cupida* sp. nov., sagittal section through genital organs. × 40.
7. *Pseudostylochus edurus* sp. nov., sagittal section through genital organs. × 40

Plate XXXIX

1. *Pseudoceros exoptatus* sp. nov. × 1
2. Ditto, sagittal section through genital organs. × 26.
3. *Prosthiostomum vulgaris* sp. nov., anterior end of body. × 15
4. Ditto, sagittal section through genital organs. × 40
5. *Prosthiostomum laetum* sp. nov., anterior end of body. × 15.
6. Ditto, sagittal section through genital organs. × 73
7. *Prosthiostomum auratum* Kato, anterior end of body. × 15
8. *Pseudostylochus maculatus* sp. nov., sagittal section through genital organs. × 26
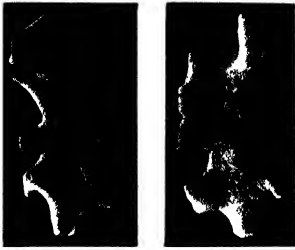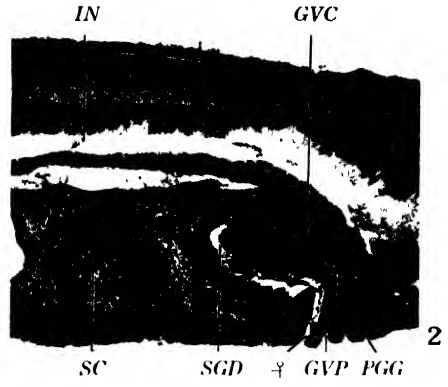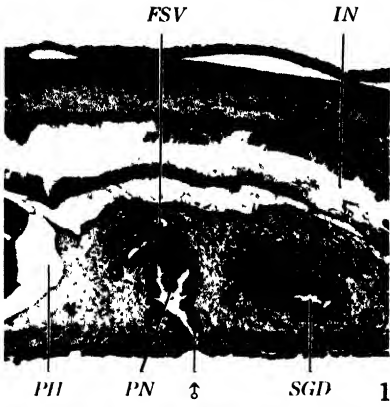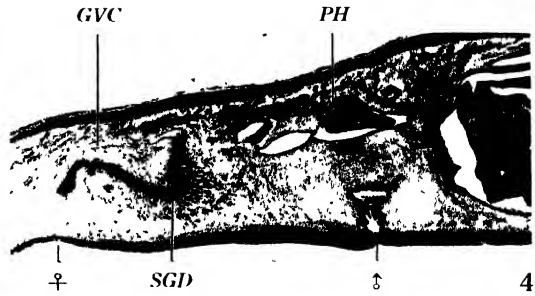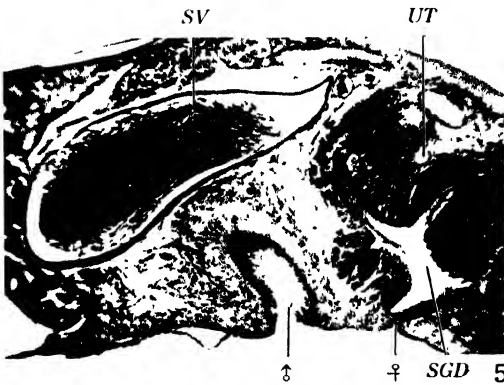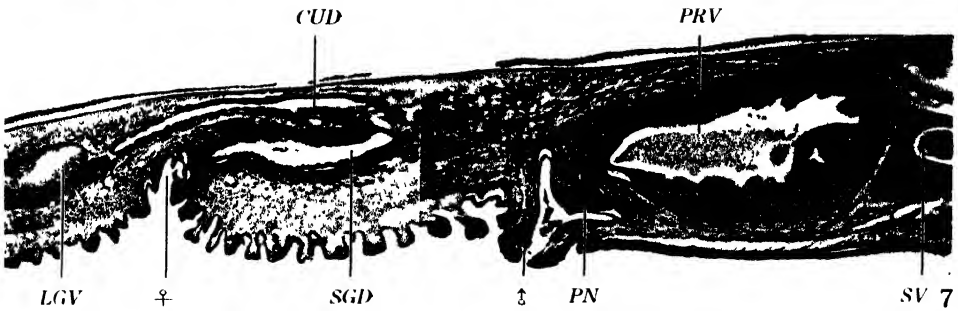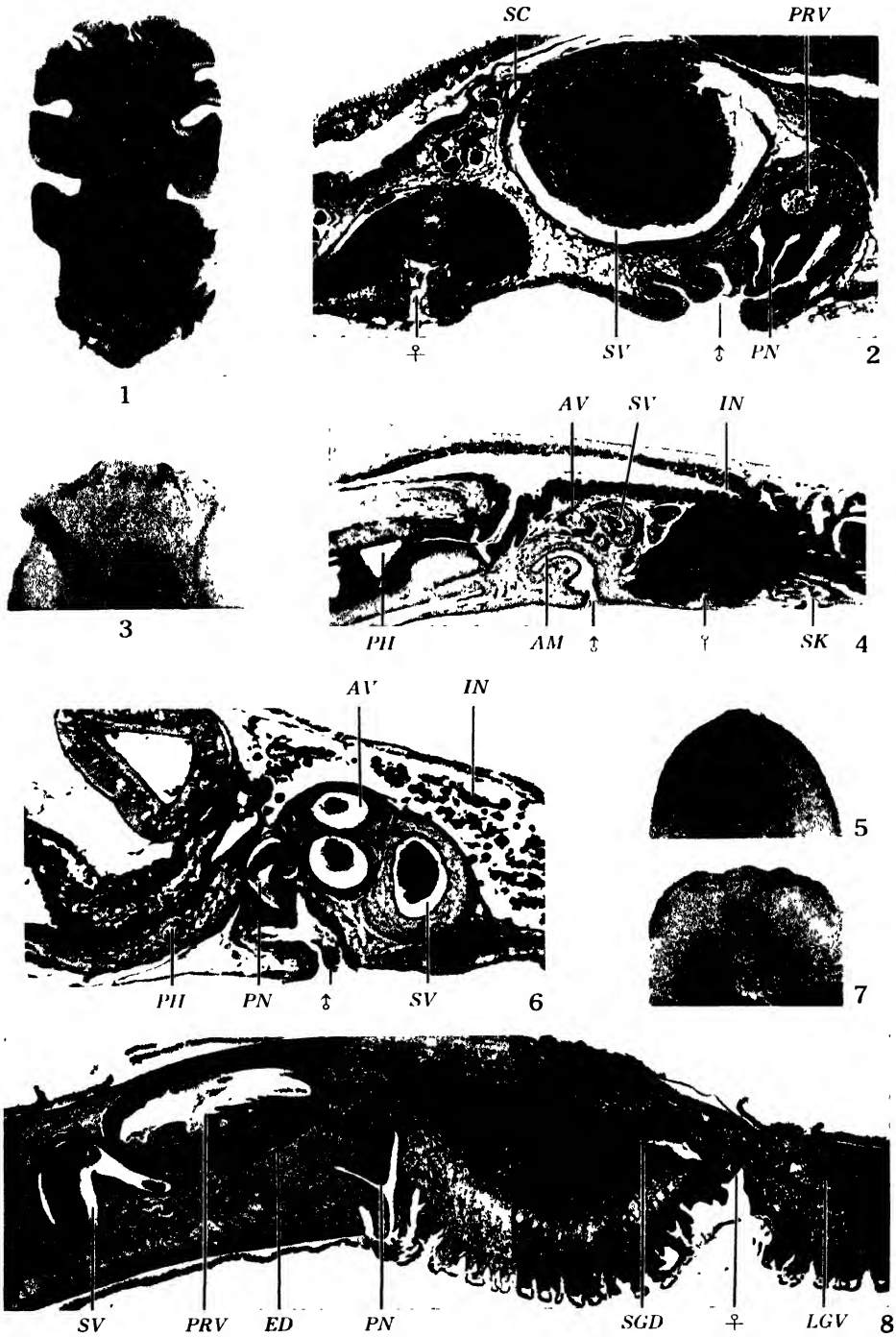
27. Notes on Pelagonemertes moseleyi Bürger

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(With 2 Text-figures and Plate XI.)

Shortly after the first discovery of a pelagic nemertean, *Pelagonemertes rollestoni*, from far south of Australia, another specimen of *Pelagonemertes* was obtained by the Challenger on June 5, 1875, from a depth of 755–420 fathoms at about halfway between Oosima and Cape Sagami, and Moseley (1875 b) supposed it to be a young form of *P. rollestoni*. Bürger (1895), however, based on the differences of the shape of body and the number of intestinal branches, separated the Japanese form from the Australian one giving the former the name *Pelagonemertes moseleyi*. By the extensive surveys of the Albatross, the Valdivia and the Deutsche Südpolar expedition, a certain number of specimens of *rollestoni* as well as other two new species, *joubini* and *brinkmanni* (Coe, 1926), were collected from various seas of the world, while, so far as we are aware, no nemertean referable to *P. moseleyi* has been recorded since.

In the middle of November, 1937, one of the writers, Otohiko Tanaka, obtained several specimens of pelagic nemertean along with a large number of deep-sea medusae, copepods, arrow-worms, etc., by the vertical net from about 1,000 meters to the surface, at a station 3 miles off Hasima in Sagami Bay.

After close examination, two of the nemertean specimens revealed to be referable to *P. moseleyi* mentioned above. Though the Challenger's example was carefully studied while living, it was destroyed in an attempt of preservation, and the minute internal organizations of this worm have remained unknown. Here follows the emended description of the species, basing on our studies of the newly obtained material. One of the specimens was examined in serial sections.

The body is thick and broad, and the posterior end distinctly narrows, terminating in a more broadened caudal fin as in *P. brinkmanni*. The lateral margins are slightly undulating, but provided with no such distinct indentations as mentioned by Moseley. They are very thin near the posterior end of the body, looking like feeble horizontal fins as observed in *Nectonemertes*.

The Challenger's specimen measures 13 mm long, 11 mm broad and 1 mm in extreme thickness. One of the present specimens measures after preservation 13 mm in length and 9 mm across the broadest part of the body, and the other specimen 17 mm by 8.5 mm. Both specimens are about 5 mm in thickness in the middle of the forebody.

The body is almost hyaline, except for the alimentary canal which is full of glanulae and bright orange in color. This coloration persists in formalin for a fairly long time. The proboscis, ovaries, brain, and nerve-cords are opaque, and clearly seen through the translucent body-tissues.

The epidermis consists of ciliated columnar cells and glandular cells of two kinds, those filled with an eosinophilous granular secretion and those with a clear mucous secretion. The former glandular cells are especially abundant in the ventral epidermis of the caudal fin. Special integumentary sense-organs, similar to those found in *Nectonemertes* and certain other genera, are irregularly distributed on the whole surface of the body. The organ, as is shown in Fig. 2, consists of a conical group of extremely slender cells, at the base of each cell lies an elonagted nucleus. Further minute study on this organ is hardly possible owing to the poor state of preservation. The dermal musculature of the body is slightly developed, composed of two layers of isolated muscle bundles. The outer is a single circular layer and the inner, longitudinal one which is very weak in the lateral parts of the body. The dorso-ventral muscle fibers are scarcely observable.

In the Challenger's specimen, the anterior, median end of the body is evidently bilobed, but in the present specimens, in which the proboscis is in its normal position, it is rather bluntly pointed, and here open ventrally the rhynchodeum and the mouth. The mouth, occurring immediately behind the rhynchodeal opening, leads into a short oesophagus to continue

Fig. 1. Schematic representation of *Pelagonemertes moseleyi.* ×6.
BR brain; CA caeca; CF caudal fin; ID intestinal diverticulum, LBV lateral blood vessel; LN lateral nerve; MI main intestine; MO mouth; OE oesophagus; OV ovary; PR proboscis; PRS proboscis-sheath; RC rectum; RID rudimentary intestinal diverticulum, RO rhynchodeal opening; SB sickle-shaped basis; ST stomach.

on to a large stomach, which passes by its narrow pyloric part into the dorsal wall of the intestine a short distance from its anterior end. A small portion of the intestine lies as a caecum just in front of the pylorus-opening. The main intestine runs along the median line on the ventral side of the proboscis-sheath to the hind extremity of the body. Its short terminal portion forms

the rectum which opens to the exterior in the middle of the caudal fin. The main intestine bears 5 pairs of diverticula. In one specimen, all these pairs extend out symmetrically toward the lateral walls of the body, while, in another example, the posterior four pairs arrange alternately, viz., those on the right side are considerably anterior to the members of the corresponding pairs of the left side. Lying near the first fourth of the body,
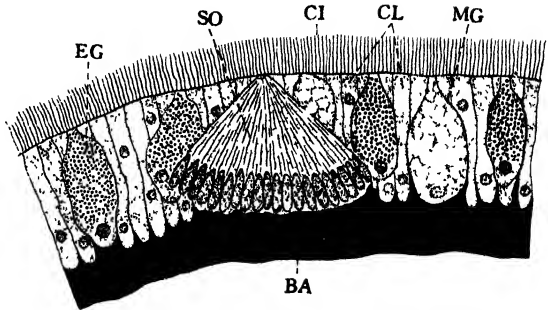
Fig. 2. Part of section through epidermis of *Pelago-nemertes moseleyi*. ×600.
BA basement membrane; CI cilia; CL columnar cell; EG eosinophilous gland; MG mucous gland; SO sense-organ.

the most anterior pair of intestinal branches are much larger than any of the others and provided with a few caecal buds at their distal ends. The remaining pairs are of simple club-shape, except for the third one having a few buds. At the junction of the intestine and the rectum, there is a group of small lobes which are apparently rudimentary caeca. The internal epithelium of the intestine consists of two kinds of cells. The larger and more numerous cells have basal nuclei and their cytoplasm is crowded with vacuoles, and the others are rather small and filled with coarse, eosinophilous secretion granules. The bright orange color of the intestinal system is due to these granules.

The rhynchodeal opening leads into a short rhynchodeum, to its muscular wall is closely attached the proboscis. The eversible proboscis is thick and long, and greatly exceeds the body in length, lying in a convoluted state in the proboscis-sheath. The proboscis has the usual three communicating chambers: the anterior, the middle and the posterior one. The epithelial lining of these three portions are each quite in accord with those of *rollestoni* or *brinkmanni*. The small middle chamber contains, as usual, the armature which is represented by a sickle-shaped basis, the anterior free border of it bears about 7 stylets. Each stylet consists of a discoid base and a blunt, conical tooth. The proboscideal nerve consists of 11 large nerves alternating with an equal number of somewhat smaller ones, making a total of 22 nerves. The proboscis-sheath is very large and long, occupying nine-tenths the body length. It is almost spindle shape and the posterior part tapers to a narrow tube, which ends blindly in the midst of the surrounding parenchymatous tissue between the intestine and the dorsal body-wall. The muscular wall of the sheath is of far greater thickness than are the body-walls, consisting of two distinct layers: the outer, thick circular layer and the inner, thin longitudinal one.

The lateral blood vessels run parallel with the lateral nerve-cords and are united with three anastomoses; one of those is above the rectum, the second immediately above the rhynchodeum just anterior to the attachment of the proboscis, and the third beneath the proboscis-sheath just posterior to the

ventral brain-commissure. Arising from the ventral anastomosis, a very short, dorsal, median vessel passes obliquely through the ventral wall of the proboscis-sheath to terminate blindly in rhynchocoel.

The brain is relatively small, while, the lateral nerves are very thick. They run about midway between the median line and the lateral borders of the body, and unite by a broad commissure above the rectum, a little more posteriorly than the anastomosis of the lateral blood vessels.

The two specimens available for study are both females as the Challenger's material. The ovaries arrange on the ventral side along the lateral blood vessels as if they were connected with the latters. The number of ovaries seems to be variable in this species. The Challenger's specimen has 8 ovaries on the right side, 7 on the left. In one of our specimens, there are 7 on the right, 8 on the left, and in the other, 7 on the left and 6 on the right. The ovary is spherical in shape, containing a few ova of varying developmental stages. It opens to the ventral side by a narrow oviduct which is lined with distinct columnar cells. According to Moseley, the oviduct makes its way to the dorsal side, but, his observation is erroneous as pointed out by Brinkmann.

As already mentioned, the present specimens differ from Moseley's original example in the possession of the caudal fin. However, judging from his description and figure, the Challenger's worm seems to be slightly injured and in a state of strong contraction. Therefore, it may be safely asserted that our material is identical with *P. moseleyi*. This species is easily distinguished from *rollestoni* and *joubini* by the presence of the caudal fin just mentioned, and from *brinkmanni* by the arrangement of the intestinal branches and the number of the proboscideal nerves.

The male individual of this species has never been captured.

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PLATE XL

Pelagonemertes moseleyi Bürger

A. Natural size.

B, C. Enlarged.

D. Transverse section at the level of the third pair of intestinal diverticula. ×40.

E. Transverse section through middle chamber of proboscis showing sickle-shaped basis. ×57.

F. Part of section through epidermis showing two sense-organs. ×140.

ABBREVIATIONS

1. anterior chamber of proboscis; *2.* middle chamber of proboscis; *3.* posterior chamber of proboscis; *4.* sickle-shaped basis; *5.* rhynchocoel; *6.* main intestine; *7.* lateral diverticulum of intestine; *8.* ovary; *9.* oviduct; *10.* lateral blood vessel; *11.* lateral nerve; *12.* integumentary sense-organ.

A

B

C
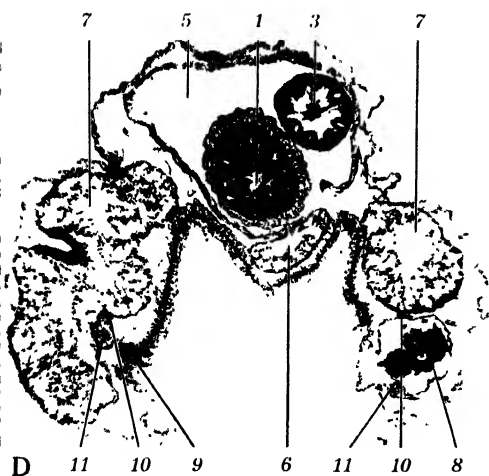
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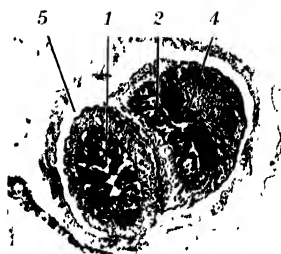
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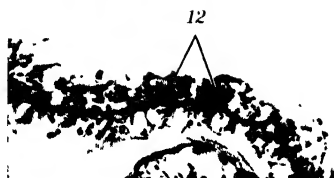
F

28. Note on Calanus cristatus Kröyer

By Otohiko Tanaka

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(With 2 Text-figures)

Since Kröyer had in 1848 first described *Calanus cristatus* by the specimen from Kamchatka, several authors had the opportunities to observe the same species collected in different parts of the world. But all the specimens they examined, so far as I know, were only immature females and not a single male nor adult female has been reported. This species of cold region is very abundant in the northern waters of Japan. The species is easily recognised by its large size and the crest on the forehead. In November 1937, vertical hauls were carried out with a stramin net of 1 metre diameter in the deep waters of Sagami Bay. The collected sample contained not only adult females but also males of the present species. Some of the females carried in the ovary eggs measuring about 0.3 mm in diameter. In the following I give a brief description and figures.

Female: Length 8.4–9.3 mm. Abdomen is contained 4.6-times in the length of the cephalothorax. Lengths of the abdominal segments and furca in 0.01 mm 71, 25, 13, 14, 32 (Fig. 1. a). Furca about 1.4-times as long as wide. Genital segment with a small protuberance on the middle of the genital orifice (Fig. 1, b, c). Forehead with a median crest.

Distal joints of the antennules were broken off in all specimens. Mouth appendages are of the normal *Calanus* type. Swimming feet with 3-jointed exopodite and endopodite. In the 5th feet (Fig. 1, f), inner margin of the 1st joint of the basipodite smooth and without marginal seta; the outer marginal spine on the 3rd joint divides the outer margin in the proportion 5 : 4; the inner margin has 4 setae; the 1st joint of the endopodite with a spine on the outer edge and this is rudimentary in the 2nd to 4th feet; the 3rd joint with 4 inner marginal setae.

Male: Length 7.4–8.6 mm. Male resembles female in general appearance except the low median crest (Fig. 2, a, b). Abdomen (Fig. 2, c) is contained about 3.5-times in the total length of the cephalothorax. Abdomen is 5-jointed; the lengths of the abdominal segments and furca in 0.01 mm are 27, 57, 32, 18, 20, 21.

Antennules 24-jointed, extend beyond the end of the abdomen by last 3 joints. Lengths of the joints measured along the posterior margin in 0.01 mm are as follows:

Joint:	1–2	3	4	5	6	7	8	9	10	11	12	13	14
Length:	54	39	25	29	27	27	22	22	32	36	41	45	48
Joint:	15	16	17	18	19	20	21	22	23	24	25		
Length:	48	50	50	50	52	43	39	36	30	25	18		

Mouth appendages well developed except the 1st maxillipede (Fig. 2, d).

1st to 4th swimming feet as in the female. 5th feet (Fig. 2, e) resemble those of *C. gracilis*. The 3rd joint of the exopodite of the right foot without
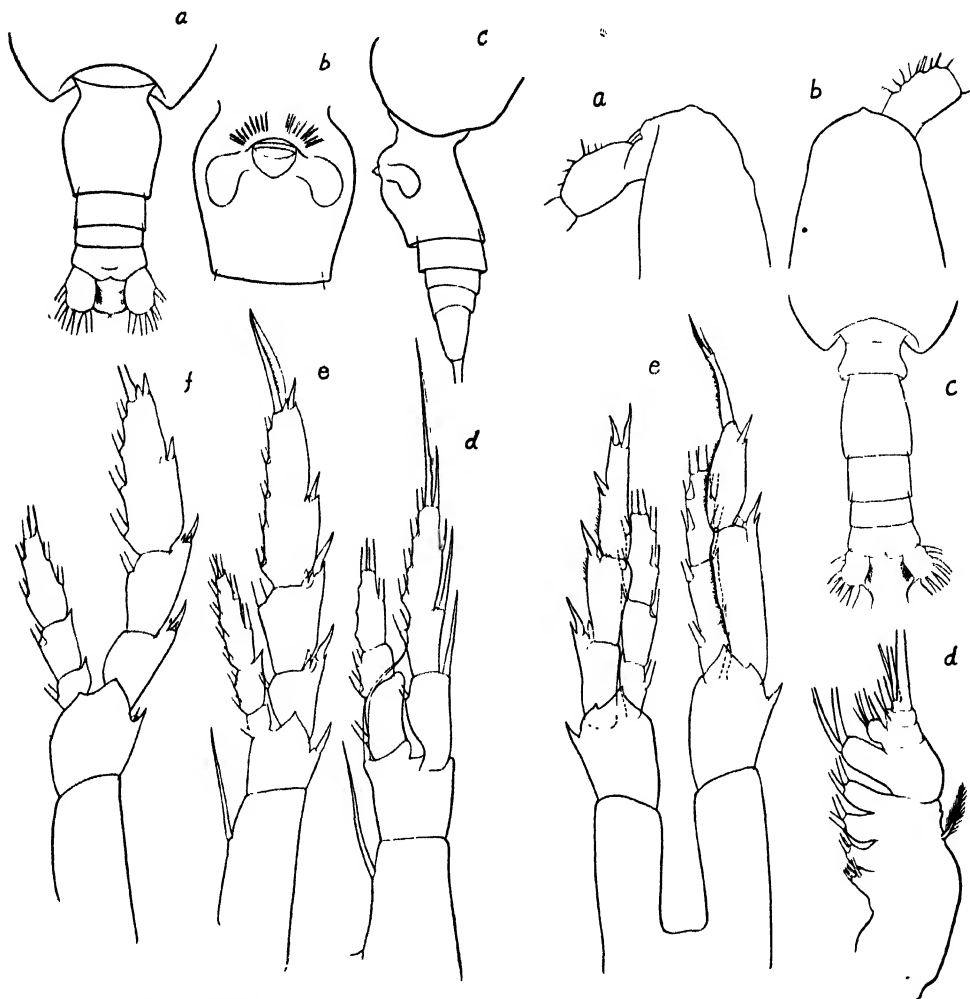
Fig. 1. *Calanus cristatus*. Female.
  a, abdomen, dorsal view, ×18
  b, genital segment, ventral view, ×30
  c, abdomen, lateral view, ×18
  d, 1st foot, ×43
  e, 4th foot, ×30
  f, 5th foot, ×43

Fig. 2. *Calanus cristatus*. Male.
  a, head, lateral view, ×13
  b, head, dorsal view, ×13
  c, abdomen, dorsal view, ×18
  d, 1st maxillipede, ×60
  e, 5th feet, ×43

inner marginal seta. The 1st and 2nd joint of the exopodite of the left foot are densely fringed with rather stiff hairs along the inner margin ; the terminal spine on the 3rd joint is furnished with spinules.

Immature specimens are all female and have 2-jointed exopodite and endopodite in the 5th feet. They measure 7.8–8.7 mm in total length.

Occurrence : 14 adult females, 6 males and 24 immature females in the vertical hauls from 1,000 m to the surface.

Distribution : The species has been recorded from the Behring Sea, Kamchatka and Japan Sea. It is also very common in the northern waters of Japan in the surface layer. I had previously collected a great quantity of immature specimen from the Aleutian Islands. Breemen reported the occurrence of this species in the deep waters of 560–1500 fathoms in the Atlantic (52°N).

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29. Studies on the Helminth Fauna of Japan
Part 23. Two New Species of Amphibian Nematodes

By Satyû YAMAGUTI

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(With 2 Text-figures and Plate XLI)

One of the species here described is the commonest frog nematode in Japan but the other one representing a new family is very rare, inasmuch as it has been found only once during the long course of my research.

Gyrinicola japonica n. g., n. sp.
Pl. XLI, Figs. 1–4.

About twenty specimens of this worm were found in the feces discharged by a tadpole of *Rana rugosa* Schlegel from near Kyoto on September 30, 1936. They were examined in life, then fixed in alcohol and mounted in lactophenol.

FEMALE. Body 2.0–3.7 mm long by 0.15–0.3 mm broad, cylindrical except for extremities. The esophageal region tapers gradually toward the head, which in turn narrows more rapidly and is truncated at the end. Tail 0.2–0.31 mm long, conical, terminating in a slender process 0.13 0.16 mm long. Cuticle smooth throughout, though frequently folded transversely at the neck region in fixed examples. Lateral flanges and caudal alae absent. Nerve ring 0.1–0.165 mm from head end. No cervical papillae. Excretory pore 0.27–0.46 mm behind esophageal bulb.

Mouth with six small lips, two lateral and four submedian. Each lateral lip is provided with a very prominent horn-like amphid and each submedian one with a hemispherical papilla. Mouth cavity relatively wide, not forming chitinous capsule, leading directly into esophagus. Neither vestibule nor pharynx. Esophagus 0.3–0.46 mm long, divided by marked constriction into anterior cylindrical portion 38–48 μ broad and posterior subglobular bulb 90–126 μ broad. The anterior portion has a triradiate lumen and the posterior a valvular apparatus consisting of three ridges projecting into the lumen. The cuticular lining of the esophagus is continued on to the very beginning of the intestine. Esophageal gland well developed, especially in the bulb. Intestine dark brown in life, with bulbous swelling at its anterior end, almost uniformly wide elsewhere, surrounded by three (one ventral and two lateral) large oval cells at its junction with rectum.

The single tubular ovary, originating at some distance in front of the anus with its proximal end turning forward, runs up to the level of the excretory
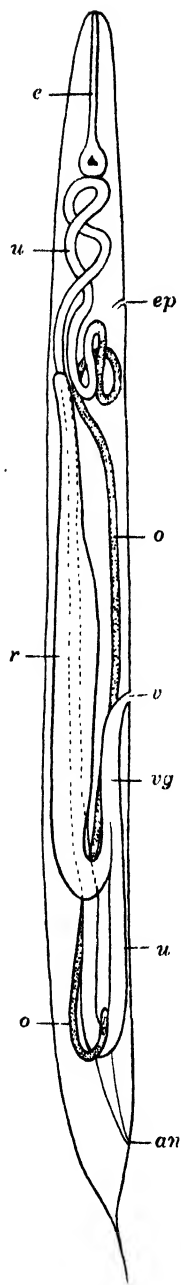
Fig 1. *Gyrinicola japonica.* Lateral view of female, showing genitalia diagrammatically.

pore, where it first turns backward and then forward in an S-shaped curve and passes into the uterus forming somewhat complex loops at the anterior part of the intestine. The descending uterus reaches to a point some distance in front of the anus, then turning back on itself proceeds anteriad and joins a fusiform organ to form the muscular vagina 0.15–0.3 mm long. The fusiform organ, which I propose to call " uterine reservoir ", is lined like the uterus proper with a layer of flat epithelia and contains several free males and eggs in various stages of development, and lies at about the middle of the body, with the rod-shaped anterior end reaching to near the excretory pore and the posterior turning forward to open into the vagina. It may be considered the vestige of a uterus, now functioning as reservoir of males. Vulva postequatorial, dividing body in ratio of 1.1–1.33 : 1. Eggs double-shelled, each containing two to four large blastomeres ; outer shell elliptical in side view, trilobate in transverse section, very finely and densely dotted on inner surface, $87-96 \times 48-54\,\mu$ in life ; inner shell elliptical, closely applied to ovum, $51-54 \times 31-33\,\mu$ in life. Some eggs in the uterine reservoir mentioned above are elongate, 120-$126\,\mu$ long by 30-$36\,\mu$ broad and contain a morulated ovum.

MALE. Body cylindrical for the most part, 0.8–0.87 mm long by 50-$60\,\mu$ broad, tapering anteriorly at esophageal region. Head blunt-pointed. Tail acute, $\aleph 0\,\mu$ long, with a pair of papillae on ventral side about $50\,\mu$ from its tip. Nerve ring 60-$63\,\mu$ from head end. Excretory pore about 0.1 mm behind esophageal bulb. Esophagus 0.114–0.12 mm long ; bulb 28-$32\,\mu$ in diameter. Testis turning backward $50\,\mu$ behind esophageal bulb. Spicules unequal, simple, pointed ; the posterior, only slightly curved near proximal end, 42-$44\,\mu$ long ; the anterior curved at about its middle, a little longer than the posterior. Gubernaculum absent. Cloaca opening on a prominent conical protuberance provided with a fairly conspicuous swelling on posterior side. A pair of small papillae on anterior side of cloacal cone near its end, and another immediately behind cloacal aperture In younger males no spicules have been observed.

This oxyuroid nematode is characterized by the male being enclosed in one of the uteri of the female, which has been transformed into a fusiform sac functioning as reservoir of males and eggs. So far as the

female genitalia are concerned, the present species occupies a position intermediate between the Atractidae possessing a single ovary and the other families of the Oxyuroidea possessing two ovaries. Therefore it represents not only a new genus but also a new family, for which the name Gyrinicolidae is proposed, with the following diagnosis.

Gyrinicolidae n. fam.

FAMILY DIAGNOSIS. Oxyuroidea Railliet, 1916. Females with one ovary and two uteri, one of which is transformed into a sac enclosing males.

Gyrinicola n. g.

GENERIC DIAGNOSIS. Gyrinicolidae n. fam. Body cylindrical, without lateral flanges. Mouth with six lips, of which the lateral has a very prominent amphid and the others have one papilla each; vestibule and pharynx absent; esophagus divided by marked constriction into anterior cylindrical portion and posterior bulb containing valvular apparatus. Excretory pore some distance behind esophageal bulb. Male: tail acute; caudal alae absent; cloacal region projecting prominently, with few anal papillae; spicules unequal; gubernaculum absent. Female: tail conical, prolonged into a slender process; vulva near middle of body. Viviparous. Parasites of tadpoles.

Genotype. *Gyrinicola japonica.*

Cosmocerca japonica n. sp.
Pl. XLI, Figs. 5-7.

This worm is very common in the large intestine of *Rana nigromaculata* Hallowell and *R. rugosa* Schlegel from near Kyoto. It was also found in *R. japonica* Günther from Mount Hiei and *Hyla arborea japonica* Günther from Suwa, Nagano Prefecture. The following note is based on a single male from *R. nigromaculata* and numerous females from the same host species as well as from the other species mentioned above.

MALE. Body 1.8 mm long by 0.15 mm broad, with its posterior portion curved ventrally in form of a hook, provided with narrow lateral flanges and six longitudinal rows of minute papillae, which are more closely set in the pre- and postanal regions than elsewhere. Head 22 μ in diameter. Tail rapidly tapering posteriorly, 0.12 mm long on ventral margin, tipped with acicular spine 13 μ long. Pharynx short cylindrical, 12 μ in diameter, projecting into mouth in three conical processes. Esophagus 0.3 mm long; anterior cylindrical portion 0.21 mm long by 24 μ broad; posterior glandular portion flask-shaped, 60 μ broad in diameter, containing valvular apparatus. Intestine wider at its anterior half. Rectum vesicular. Pre-anal cuticle thickened, ornamented ventrally with five pairs of plectanes. Each plectane consists of two chitinous rods with very fine transverse ridges on the surface and jointed with each other in the shape

of a λ, with the conical pulp in the interspace. In ventral view the posterior end of the anterior rod projecting over the surface of the cuticle appears to be surrounded by a semicircle of six very small chitinous tubercles. There is a single, well-chitinized, two-segmented spicule consisting of a slightly curved pointed shaft 70 μ long and a broader root 34 μ long. Immediately ventrolateral to the spicule lies a pair of homogeneous, strongly refractive laminae, each of which is approximately ellipsoidal in side view and measures 84 μ long by 45 μ wide. At the level of the cloaca there are five pairs of papillae, three of which are in line with those of the body mentioned above and the other two immediately lateral to the cloacal aperture. Immediately in front of this aperture is a large median papilla and a little behind it are two relatively large ones, one on either side of the median line. The other tail papillae appear to be in the same longitudinal rows of the body papillae.

Testis 0.075 mm broad, extending from second pair of plectanes to a point 0.275 mm behind esophageal bulb, where it turns backward. Excretory pore on a level with esophageal bulb.

FEMALE. Body 2.9–4.9 mm long by 0.17–0.35 mm broad at about middle, whence it tapers gradually toward the head but rapidly at the tail which is 0.3–0.49 mm long and terminates in a simple slender process 0.14–0.18 mm long and provided with a pair of minute lateral spines at a point 90–130 μ from the tip. Lateral flanges up to about 20 μ broad, extending from 0.07–0.1 mm behind head end to base of tail process. There are four longitudinal rows of minute papillae extending for the same length of the body as the lateral flanges. Nerve ring 0.1–0.17 mm from anterior extremity. Excretory pore transversely elongated, up to 45 μ wide, level with esophageal bulb or a little behind it. It may be in front of the bulb when the head end is retracted. Mouth with three lips; each subventral lip bears one papilla but the dorsal two. Pharynx 15 − 21 × 21 − 45 μ, projecting into mouth cavity in three pyramidal processes. Esophagus 0.36–0.5 mm long; anterior cylindrical portion 30 51 μ broad, posterior glandular bulb 87–126 μ in diameter, containing valvular apparatus. Intestine wider anteriorly, dark brown throughout, surrounded at its posterior end by three large ovoid cells containing fine granules and projecting into body cavity. Rectum 90–
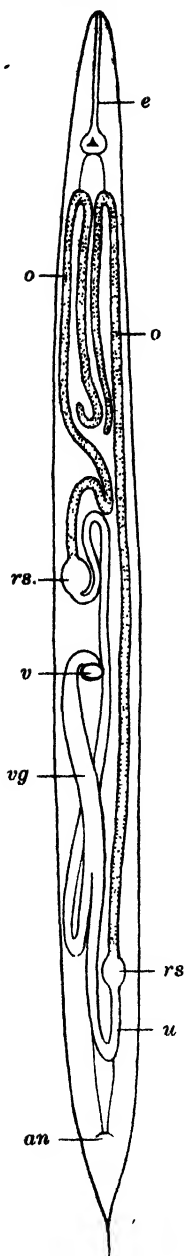
Fig. 2. *Cosmocerca japonica.* Ventral view of female, showing genitalia diagrammatically.

120 μ long, lined with thick cuticle.

The two ovaries arising at a pre-equatorial level proceed forward and turn back on themselves 0.11–0.45 mm behind the esophageal bulb and pass each into the oval receptaculum seminis, one in front of the vulva and the other further posteriorly. The uterus arising from the anterior receptaculum seminis runs forward for a short distance and then turning backward reaches to near the posterior receptaculum seminis, where it turns forward to join its fellow descending from the posterior receptaculum seminis and bending forward at varying levels according to individuals. The vagina runs forward and turns back on itself before opening to the outside. Vulva usually only a little behind middle of body. Eggs ellipsoidal, thin-shelled, containing active embryo.

LARVA. As killed in 70% alcohol and mounted in lactophenol, the hatched larva is 0.42–0.48 mm long by 24–27 μ broad, with pointed tail 6–75 μ long. Nerve ring 27–30 μ from head end. Excretory pore in front of esophageal bulb, 90–95 μ from head end. Pharynx short cylindrical, $9 \times 6 \mu$. Esophagus 102–114 μ long, with oval bulb 13–15 μ in diameter.

This species differs from the most closely related *Cosmocerca parva* Travassos, 1925, chiefly in body size as well as in the structure of the spicule. That the tail of the male is provided at the tip with an acicular spine is also worth noting.

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EXPLANATION OF PLATE XLI

Figs. 1–4. *Gyrinicola japonica*
Fig. 1. Female, lateral view, ×25.
Fig. 2. Male, lateral view, ×75.
Fig. 3. Head of female, lateral view, ×315.
Fig. 4. Female terminal genitalia, lateral view, ×25.

Figs. 5–7. *Cosmocerca japonica*
Fig. 5. Female, lateral view, ×25.
Fig. 6. Male, lateral view, ×35.
Fig. 7. Anal region of male, lateral view, ×300.

ABBREVIATIONS USED IN FIGURES

a	amphid	*pl*	plectane
an	anus	*r*	uterine reservoir
e	esophagus	*rs*	receptaculum seminis
eb	esophageal bulb	*sp*	spicule
ep	excretory pore	*t*	testis
i	intestine	*u*	uterus
o	ovary	*v*	vulva
p	papilla	*vg*	vagina

30. On the Life History of Loxogenes liberum Seno, 1907, with Special Reference to the Cercaria

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(With 3 Text-figures)

Okabe has recently determined experimentally that the cercaria of *Loxogenes liberum* Seno develops in *Bulimus kiushuensis* Hirase and encysts in *Sympetrum darwinianum* Selys and *Orthetrum albistylum* Selys. I have also succeeded in obtaining encysted metacercariae of this worm from *Orthetrum albistylum* Selys and *Crocothemis servilia* Drury by an experimental infection with a stylet cercaria of the "Virgula" group of Sewell which developed in small plump sporocysts in *Bulimus striatulus japonicus** from a village near Okayama where the frog trematode occurs not uncommonly.

As measured in life under a cover slip the oval body of the cercaria, finely spined all over, varied from 0.084 to 0.17 mm in length and from 0.05 to 0.084 mm in breadth according to states of contraction; when extended it may be up to 0.224 mm by 0.098 mm broad. The tail measures in the same condition 0.05–0.112 mm long by 14–17 μ broad. There are thirteen hairs on each side of the body, though not mentioned by Okabe. The oral sucker containing the virgula organ at the base is 25–34 μ long by 25–39 μ broad, and the postequatorial acetabulum 17–22 μ in diameter. The stylet is 17–19 μ long by 3–4 μ broad. There are constantly four pairs of pyriform penetration glands, one directly behind another. The secretion granules, unstained with neutral red, are coarser in the anterior two pairs than in the posterior two, and the gland ducts of the anterior group are made up on each side into a bundle like those of the posterior group and lie medial to the latter, with their openings near the stylet, ventral to those of the posterior glands. The collecting vessel arising from the tapering anterior end of each limb of the V-shaped excretory vesicle divides into three tubules, each of which terminates in two flame cells. The flame cells are so difficult to detect that Okabe found only one pair, but a continued observation has revealed the presence of three pairs on each side, two in the forebody and one in the hindbody, making a total of 12.

The numerous, fine, strongly refractive granules are seen scattered in the parenchyma of the living worms as pointed out by Okabe, but disappear after fixation in acetic sublimate.

The measurements made on three mounted specimens fixed in acetic sub-

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*More recently Okabe has found that this species also serves as the first intermediate host for *Loxogenes liberum.*

limate under a cover glass are as follows: Body $90-99 \times 63-66\,\mu$; tail $33\,\mu$ long; oral sucker 24–$27\,\mu$ in diameter; acetabulum $15\,\mu$ in diameter. As compared with the measurements given by Okabe the cercaria from *Bulimus striatulus japonicus* is smaller, when alive or fixed, in the size of the body, suckers, etc.

In the free tailless cercaria, which penetrated into the body of a nymph of *Orthetrum albistylum* two days before, the virgula organ as well as the penetration glands of the posterior group is no more recognizable, whereas the stylet and the glands of the anterior group persist even in the earlier stage of encystment. This fact leads us necessarily to the assumption that the virgula organ plays some important rôle during the act of penetration into the body of the dragon-fly nymph and that its disappearance is correlated with the exhaustion of the posterior penetration glands.

The cyst of the metacercaria obtained from *Orthetrum albistylum* four days after infection is delicate, globular to oval, measuring 75–$80\,\mu$ by 60–$75\,\mu$, and contains numerous granules. About a month later it becomes much larger and double-walled, the outer cyst measuring $0.36-0.4 \times 0.35-0.36$ mm and the inner $0.32-0.38 \times 0.31-0.33$ mm. At this stage of development the metacercaria shows distinct anlagen of the testes and ovary. When full maturity is reached, the cyst is inclosed in a connective tissue layer of the host origin, which becomes gradually thicker and appears dark brown with increasing pigmentation, while the cyst proper and the contained metacercaria become smaller accordingly. In spontaneously infected dragon-fly nymphs from Okayama degenerating cysts are found very often. The metacercaria
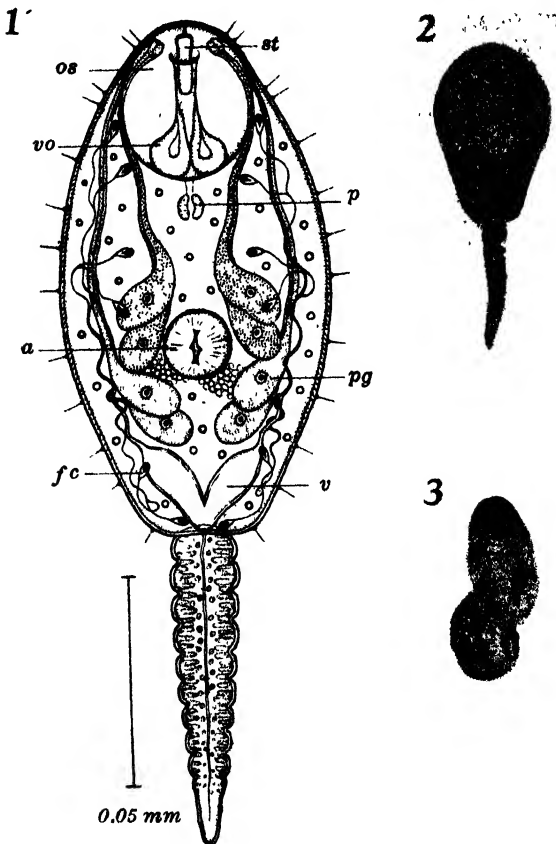
Fig. 1. Cercaria of *Loxogenes liberum* Seno; ventral view. *a* accetabulum, *fc* flame cell, *os* oral sucker, *p* pharynx, *pg* penetration gland, *st* stylet, *vo* virgula organ, *v* excretory vesicle.
Fig. 2. Free swimming cercaria; ventral view. ×200.
Fig. 3. Full-grown sporocyst. ×50.

agrees completely with that which was experimentally raised to adult in *Rana nigromaculata* in 1936.

Experiment. On June 12 several infected examples of *Bulimus striatulus japonicus* were placed in the same tank in which a number of nymphs of *Orthetrum albistylum* Selys, *Crocothemis serivilia* Drury and *Gomphus unifasciatus* Oguma from Simogamo had been kept. On July 19 numerous cysts were recovered from *Orthetrum albistylum* and *Crocothemis servilia* but none from *Gomphus unifasciatus*. Some twenty cysts were fed to each of three frogs, *Rana nigromaculata*, and nine days later an immature adult was found in one frog. The other two frogs proved negative for the parasite when killed on July 30. This unsatisfactory result is probably due to immaturity of the metacercariae used.

In conclusion it is to be noted that the nymph of *Gomphus melanops* Selys serves as a second intermediate host in the above mentioned locality near Okayama, though subordinate to *Orthetrum albistylum* Selys.

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31. On Crustacean Blood Coagulation [1]

By Haruo NUMANOI

Urawa Kôtôgakkô, Urawa

(With 13 Text-figures and 12 Tables)

CONTENTS

I

Introduction

While many papers published on the crustacean blood coagulation have been limited to the cytological observation, Loeb ('03) on *Astacus* and other crustaceans, Halliburton ('85) on the Decapod crustacea and Alsberg and Clark ('08) on *Limulus* studied physiologically the mechanism of the blood coagulation, though the results were not enough theorized. Because the crustacean blood contains no true thigmocyte, erythrocyte and the property of the plasma differs much from that of vertebrates, simple deduction from the blood coagulation of the latter may be very perilous.

The basal mechanism of the blood coagulation of several crustaceans apart from that of vertebrates will be described in the following chapters.

I here express my cordial thanks to Professor N. Yatsu, Professor I. Amemiya, Dr. T. Kamada and the late Mr. S. Kikuzawa for their kind guidance and encouragement. Thanks are also due to the Mitsui Institute of Marine Biology where facilities for the investigation were afforded during the summers of 1936 and 1937. The study was partly aided by the grant of the Ministry of Education.

II

Effect of Temperature on the Coagulation of the
Blood of *Ligia exotica*

Method

Fully grown males, 35–45 mm in length with no sign of ecdysis were used in all of the experiments. When the basal parts of both antennae were

cut, the blood flowed out in drops, 4 drops being 0.10–0.12 cc.

The temperature of the blood was controlled by immersion in the ordinary water bath for the higher temperature range and by placing in the newly devised apparatus (in which the temperature was constant for short intervals only) for the low temperature.

Main part of the apparatus consisted of three-hold aquaria. In order to insulate the effect of outside temperature, cotton was propped into the space between the outer and the middle. Ice and water were introduced between the middle and the inner as a cooling mixture. Tap water was flowed in and out to keep the temperature of the inner aquarium constant. As the observation could be finished within ten minutes, this apparatus served well for the purpose. Dark violet coloured, thick walled hollow slide-glass was kept horizontally by the glass knife edge in the inner aquarium. The mode of the blood coagulation could be observed with ease from outside. The temperature of the subterranean laboratory was about 25°C throughout the experiment.

Mode of blood coagulation

The coagulation of the blood poured out on the slide-glass begins from the marginal contact region toward the center gradually over the bottom surface (Fig. 1), then the thin film of the coagulant is formed on the surface of the blood, and the blood between these two layers remains liquid to the last. The process of the coagulation might be divided into four successive stages, i. e. marginal coagulation, bottom coagulation, surface film formation and perfect coagulation, when the blood changes into the gelatinous clot.
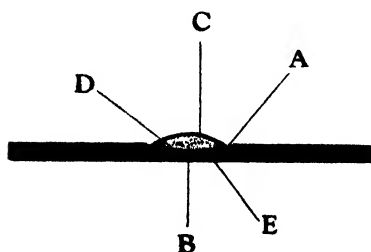
Fig. 1. Diagranatic illustration of mode of blood coagulation.
A, marginal coagulation
B, bottom coagulation
C, surface film formation
D, perfect coagulation
E, slide-glass

The stage of surface film formation is observable easily from outside. After this time, the end point of the perfect coagulation can be determined by the frequent inversion of the inner aquarium.

Limit of temperature for coagulation

Loeb ('03) described that heating of the crustacean serum to 46°–50°C for 30 minutes, prevented the coagulation. Moreover it can be prevented by the previous heating of the animal; the blood of *Limuli* heated for 30–40 minutes up to 50°–54°C did not coagulate after having been shed. Lobster and *Lebinia*, heated to 45°–48°C, for 30 minutes lost their coagulability. Halliburton ('85) also described that if the blood of crayfish be kept at the temperature of melting ice, it remained liquid. And after an hour on removal from the cold it coagulated as usual, only more slowly, the jelly not being firm for 20 minutes.

The coagulation of the blood of *Ligia exotica* is prevented at 50°C for 30 minutes, though it coagulates at 45°C within a minute. The high limit of the temperature for coagulation is 46°C. While the blood remains liquid below

4°C for 10 minutes, it freezes near −2°C. When the frozen blood is removed to the optimum temperature, it restores its coagulability again. The effect of the superheating is, on the other hand, irreversible.

Adaptation temperature and temperature coagulation curve

The seasonal effect on the blood coagulation of *Ligia exotica* is remarkable, the time of the coagulation differing markedly in summer and in winter at the same temperature, so the effect of adaptation temperature for the coagulation is examined.

Animals were adapted in three different temperatures 10°, 20° and 30°C respectively prior to the experiment for a day or two. If the time of blood coagulation of these animals is plotted against temperatures between the limit for coagulation, three caternary curves are drawn as are shown in Fig. 2.
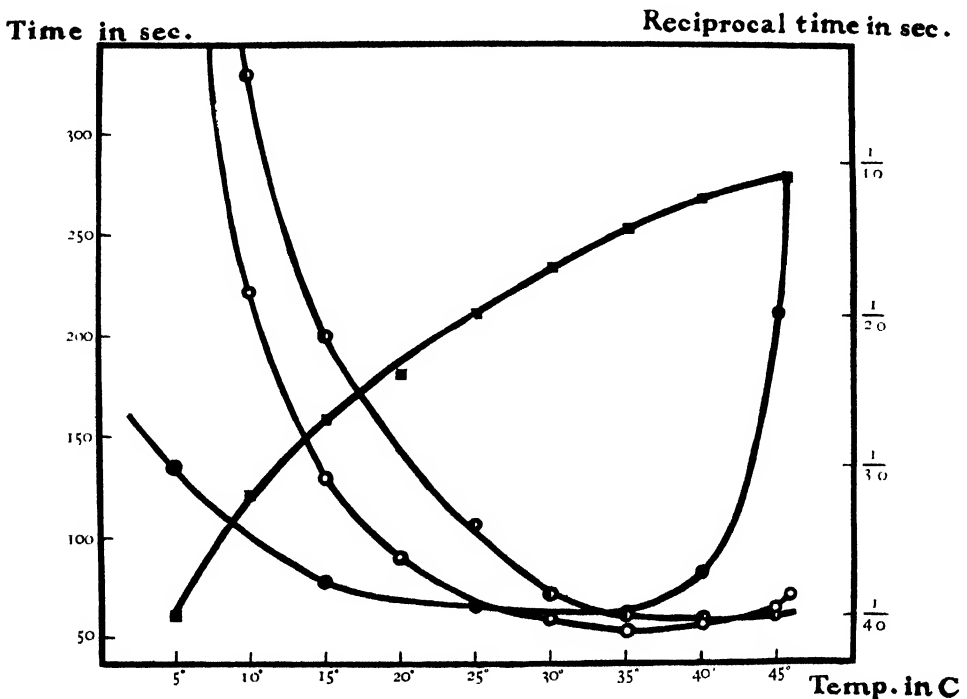
Fig. 2. Temperature coagulation curves at different adaptation temperatures and temperature viscosity curve of the blood of *Ligia exotica*. ◖) coagulation curve at 10°; ○ at 20°; ● at 30°C adaptation respectively. ■ viscosity curve.

Each curve has the minimum time of coagulation near 35°C, which is vague in those previously kept at 10°C, while very clear in 30°C adapted animals. Whatever the adaptation temperature may be, the lower the temperature the more decreased the coagulability below the optimum temperature, while the relation is reversed in the higher temperature. Moreover, the temperature coagulation curves show that the coagulation time of the cold adapted animal

is longer than the warm adapted one below 35°C, while in the higher temperature range this relation is reversed. The time of the blood coagulation at different temperatures for adaptation is shown in Table 1.

Table 1

Time of blood coagulation at different adaptation temperatures

Temperature	Adaptation temperatures					
	10°C		20°C		30°C	
	Observed in sec.	Calculated in sec.	Observed in sec.	Calculated in sec.	Observed in sec.	Calculated in sec.
5°	1200	1050	955	680	134	130
10°	330	380	223	250		98.0
15°	200	210	130	135	77.8	81.0
20°		130	90.0	93.0		72.5
25°	108	98.0		71.0	65.0	66.0
30°	71.7	74.0	60.0	55.0		61.5
35°	60.0	60.0	52.5	40.0	60.0	59.0
40°	57.1		57.5		81.7	
45°	60.0		63.8		210	
46°	—		71.3		—	

Effect of water contents

The habitat of *Ligia* in winter is remote from the tide marks and it lives in the clefts and under stones of sunny places. So the coagulability of the blood of the winter animal is stronger than that of summer at the same temperature owing partly to the smaller water contents.

If *Ligia* is immersed in the distilled water for about an hour, the body weight is increased and the coagulability of the shed blood is much weaker

Table 2

Effect of water contents[1]

Temperature	No. of experimentals	Time of coagulation in sec.	
		Whole blood	Diluted blood
5°	26	134.0	145.4
15°	25	77.8	116.0
25°	23	65.0	113.5
35°	17	60.0	74.3
40°	14	81.7	165.0
45°	13	210.0	—

[1] All experimental results are those adapted for 30°C.

than that of a normal one. This fact suggests that the water contents of the animal affect remarkably the blood coagulability in accordance with the temperature.

A series of experiments was carried out as follows; 4–5 drops (about 0.12 cc) blood obtained from the animal was diluted instantly by 1 drop (0.03 cc) of the distilled water. After thorough mixing the time of coagulation was measured.

As is shown in Table 2, the effect of dilution is the slightest at 35°C, while it is remarkable at both the extreme temperatures 5° and 45°C. The effect of higher temperature being much more intense than that of lower. The limit of dilution for the blood coagulability is about 2.5 times at the optimum temperature of 30°C, (see elsewhere).

Effect of electrolytes

Effect of various electrolytes appeared in company with the temperature on the blood coagulation of *Ligia exotica* was studied. Different amount of three sodium salts, NaBr, $NaNO_2$ and $NaNO_3$ was added to the blood obtained from the animal which was collected in summer, adapted in 30°C and those collected in winter, adapted in 10°C.

Table 3

Effect of electrolytes

Electrolytes added (pH 7.3)	Temperature	Drops of electrolytes added and time of coagulation in sec.							
		1	2	3	4	5	6	8	10
M/8 NaBr	28.0°C (Summer)	47.0	66.3	84.0	530	±	—	—	—
	7.0°C (Winter)	105	120	150	210	270	300	330	600
M/8 $NaNO_2$	28.0°C (Summer)	108	146	360	±	—	—	—	—
	7.0°C (Winter)	120	150	180	240		360	450	540
M/8 $NaNO_3$	27.0°C (Summer)	53.0	94.0	128	170	±	—	—	—
	7.0°C (Winter)	100	150	180	220	260	240	300	390

As is shown in Table 3, the effect of electrolytes is slight in winter and large in summer, and the effect is accompanied with that of dilution which is slight at 28°C, while marked at 7°C as can be judged from the previous result (Table 2).

As far as the amount of the electrolytes added remains small, the time of coagulation in winter is longer than that of summer, while the relation is reverse when a considerable amount is added.

Coagulant enzyme

The crustacean blood coagulation may be induced by the action of the coagulant enzyme though it is quite improbable that the theory of thrombokinase-thrombin-fibrin system of the vertebrates' blood coagulation can wholly be

put into the blood of *Ligia*.

By the foregoing temperature experiment on the blood coagulation, it was made clear that the coagulability is strongest at 35°C and becomes weaker with the change of the temperature from that. This tallies well with the general property of the enzyme having the optimum temperature for action near 37°C and its power decreasing with the change of the temperature.

Meanwhile, Costello ('34), Halliburton ('85) and others have proposed the view that the increase of the protoplasmic viscosity with the change of temperature brings about the coagulation of the egg or other cells. To see if the theory can be extended to the blood coagulation, the viscosity change of the blood was measured between 0° and 45°C by Ostwald's viscosimeter and the reciprocal time of the blood taken for flowing down the definite distance was plotted against the temperature. As is shown in Fig. 2, the blood viscosity of *Ligia* decreases with the increase of temperature in a constant curvature, while the coagulation curves have shown caternary in shapes having optimum temperatures near 35°C.

It may be supposed from the curves that the viscosity change of the blood plays an antagonistic rôle upon the blood coagulation. Combining the strongest action of the coagulant enzyme with the low viscosity, the coagulability of the blood at higher than 35°C is considerably large. But the enzymatic action gradually weakens in the higher temperature and the coagulation is suddenly suspended above 46°C. In the lower temperature range, however, the weak enzymatic action suppressing the increased viscosity, the blood remains in the liquid. The antagonistic action of the blood viscosity against the enzymatic action appears most clearly in 30°C adapted animals.

Temperature coefficient

In order to analyse the further effect of temperature on the coagulation, the temperature coefficient was calculated.

Table 4

Temperature coefficient of blood coagulation

Adaptation temperatures	Temperature coefficient				
	Q_{10}		μ		b
10°C	Q_{15-25}	2.98	μ_{15-25}	18800	
	Q_{25-35}	1.80	μ_{25-35}	10800	b_{5-35} 1.47
	Q_{30-40}	1.47	μ_{30-40}	1900	
	Q_{35-45}	1.00	μ_{35-45}	-2000	
20°C	Q_{10-20}	2.47	μ_{10-20}	17600	
	Q_{15-25}	1.73	μ_{15-25}	12500	b_{5-35} 1.40
	Q_{20-30}	1.71	μ_{20-30}	7200	
	Q_{25-35}	1.43	μ_{25-35}	5000	

	Q_{30-40}	1.04	μ_{30-40}	3500		
	Q_{35-45}	0.82	μ_{35-45}	-4100		
	Q_{5-15}	1.72	μ_{5-15}	8700		
	Q_{15-25}	1.20	μ_{15-25}	3100		
30°C	Q_{25-35}	1.08	μ_{25-35}	1500	b_{5-35}	0.42
	Q_{30-40}	0.77	μ_{30-40}	-11700		
	Q_{35-45}	0.43	μ_{35-45}	-37600		

By the famous equations of Vant'Hoff and Arrhenius modified by Yamamoto ('31), the temperature coefficients Q_{10} and μ were calculated (Table 4).

For the expression of the rate of the biological processes, Bělehrádek ('26) has proposed another empirical equation, which is $y = \dfrac{a}{t^b}$, where y being time, t temperature, a and b constants, the latter of which has the meaning of a temperature coefficient.

Previously plotted coagulation curves (Fig. 2) fitted best with this formula below 35°C and three formulae were calculated as follows, $y = \dfrac{112 \cdot 10^2}{t^{1.47}}$, $y = \dfrac{63.1 \cdot 10^2}{t^{1.40}}$ and $y = \dfrac{25.7 \cdot 10}{t^{0.42}}$ for 10°, 20° and 30°C adaptation respectively. Observed and calculated time of the coagulation coincides fairly well (Table 2).

Above 35°C, the data are insufficient to calculate the values of the temperature coefficient.

It would be needless to criticize the theory of the temperature coefficient here, but the variable values of Q_{10} and μ suggests that too complicated phenomena are involved in the coagulation process to be expressed by such equations. Whereas Bělehádek's formula holds good in this case, yielding a unique b for all temperatures examined. According to him the effect of temperature upon all the biological phenomena might be caused by the viscosity change of the protoplasma.

According to Loeb ('22), the viscosity at a given temperature depends partly on the time elasped from the moment when the solution attained the temperature equilibrium in hydrophilic colloidal solution and the influence of the temperature for adaptation remarkably appears at higher temperature than 40° and lower range than 20°C. Because the coagulant enzyme contained in the blood acts maximum near 37°C, the influence of the adaptation temperature can never appears. On the other hand, the enzymatic power of the blood is much suppressed by the temperature for adaptation at higher and lower ranges previously denoted.

The coagulant action of the enzyme is destroyed at the temperature higher than 46°C and it is irreversible. The effect, on the other hand, does not extinguish at the lower temperature even below 0°C.

Effect of external factors, dilution and electrolyte suggests that they cannot affect the action of the coagulant enzyme near 35°C where the action of the latter is the strongest, whereas the influence of the former is the most remark-

able at the temperatures lower than 20°C and higher than 40°C, where the coagulant action of the enzyme is much decreased.

III

Effect of Ions on the Coagulation of the Blood of *Ligia exotica*

It is quite obvious from literatures that the greatest diversity of opinion lies in the rôle played by the calcium on the process of blood coagulation. Still, it is a definite fact that if such anions as oxalate, citrate, and fluoride are added in the blood, the existing ionized calcium might be precipitated forming insoluble salts with them, and the coagulation does not occur. Calcium is thus an indispensable factor in the coagulation of the vertebrates' blood but it is doubtful whether it also plays the same important rôle in the crustacean blood or not.

In the present chapter the following problems are dealt with.

1) Quantitative relation, if any, between various anions added and the solubility of the calcium salts formed combining with the calcium ion present in the blood.

2) The effect of cations, such as alkali, alkali earth and heavy metal ions on the blood coagulation.

As described in the previous chapter, the effect of temperature between 25° and 35°C on the blood coagulation of the warm adapted animal is almost the same. The change of the room temperature of the laboratory was within this range throughout the experiment.

Batesman ('33) found that the blood of *Ligia oceanica* is approximately equal in concentration to the sea water. It may also be true of the blood of *Ligia exotica*. Preliminary experiment on the blood coagulation reveals that the concentration of the experimental salt solution has to be more dilute than that of the sea water, because the dissociation degree of such a concentrated solution is insufficient on one hand and the blood protein is induced to precipitate on the other.

Sodium salts with monovalent, divalent and trivalent anions were dissolved as M/8, M/12 and M/16 solutions respectively, so as they retain isotonicity with each other.

Adding different amount of drops (one drop amounted 0.03 cc) of these solutions measured by the graduated micro-pipette to the blood, the time of coagulation at each dilution and the maximum volume of solutions added without suspending coagulation were measured.

The blood of *Ligia exotica* being slightly alkaline (pH 7.8), the solutions added were controlled as to be pH=7.3 by the addition of N/10 NaOH or HCl. pH was determined colorimetrically using the borax and boric acid mixture and Merck's phenol red being used as an indicator.

Effect of anions

The coagulability of the blood is suspended when it is diluted more than

2.5 times by buffered distilled water (pH 7.3). This is taken as the standard and the effect of various ions on the coagulability is compared. If the coagulation is prevented by the smaller amount of the added solution, it may have an anti-coagulant power, while solutions having an activating power does not coagulate the blood until it is more diluted. These details are summarized in Fig. 3.
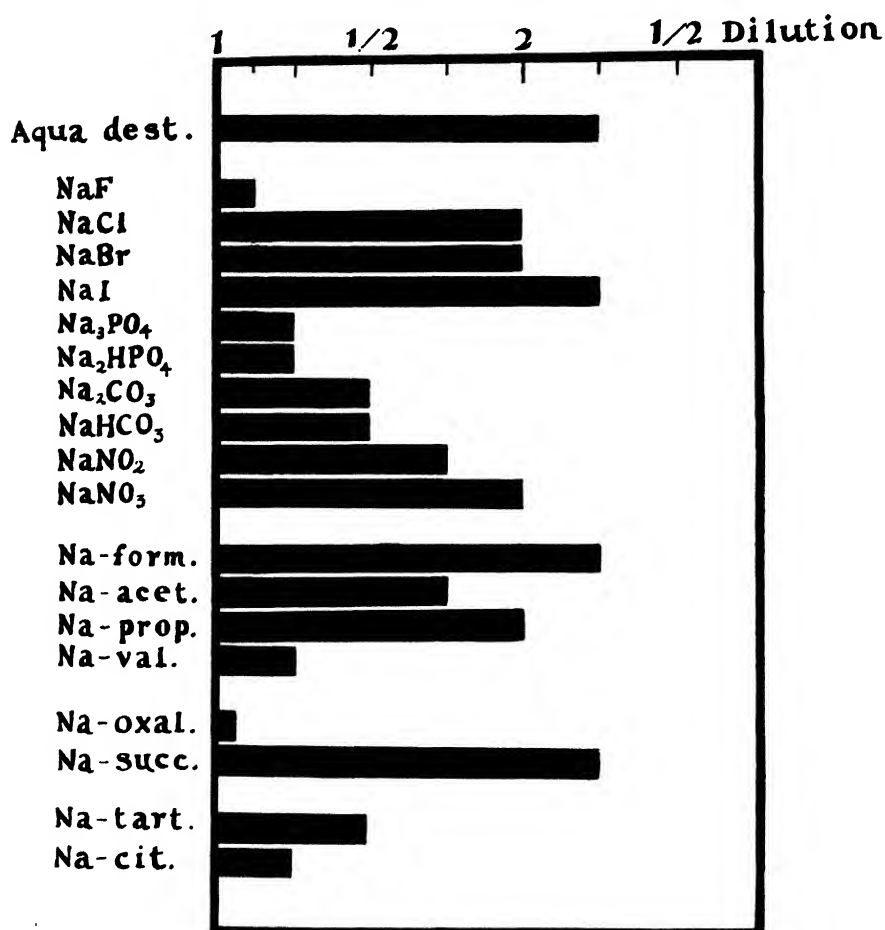
Fig. 3. Limit of coagulation diluted by various sodium salt solutions added. Limit of dilution by dist. water is $2\frac{1}{4}$ times.

a) Effect of inorganic anions: Solutions of sodium salts such as M/8 NaF, NaCl, NaBr, NaI, NaNO$_2$, NaNO$_3$, NaHCO$_3$; M/12 Na$_2$CO$_3$, Na$_2$HPO$_4$; M/16 Na$_3$PO$_4$ were almost neutral, but a small amount of N/10 HCl was added, if neccessary, to bring the pH near 7.3.
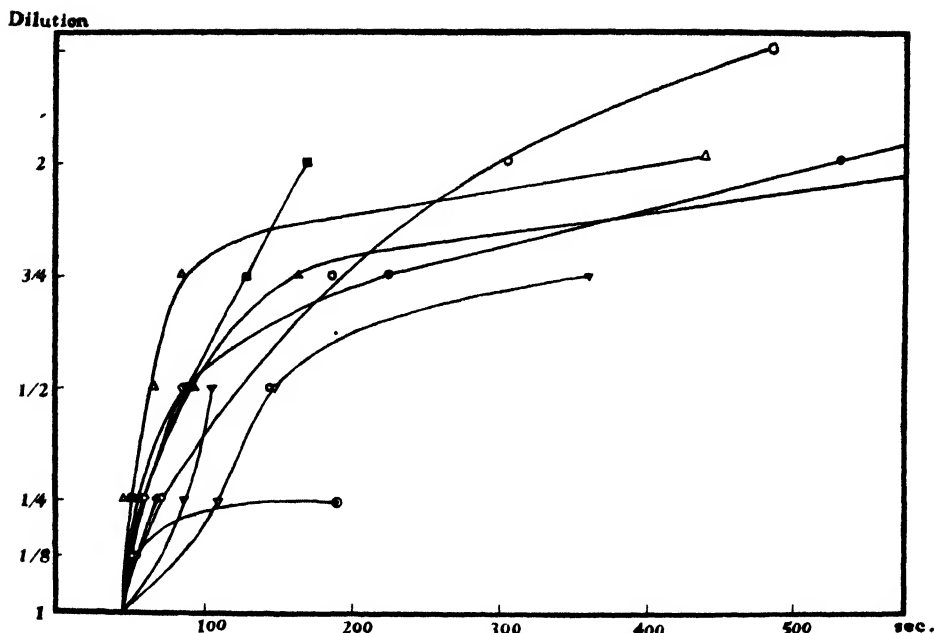
Dilution

Fig. 4. Curves showing time of blood coagulation diluted by various inorganic anions added
(pH 7.3 Temp. 26.0°–30.4°C). ● Aqua dest. □ M/8 NaF solution, ▲ M/8 NaCl
solution; △ M/8 NaBr solution; ○ M/8 NaI solution; ◉ M/16 Na₃PO₄ solution; ◆
M/12 Na₂HPO₄ solution; ◇ M/12 Na₂CO₃ solution; ▼ M/8 NaHCO₃ solution; ▽
M/8 NaNO₂ solution; ■ M/8 NaNO₃ solution.

When the effect of the solutions of sodium salts combined with halogen
series were tested, a slight anti-coagulant power was observed with the excep-
tion of fluoride. Moreover, it is conceivable from Fig. 4 that the anti-coagulant
power increases with the decrease of the molecular weight. According to the
degree of the anti-coagulant action, the halogen anions may be arranged in
the following order of series:

$$F' \gg Cl' \diagup Br' > I'$$
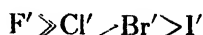
The strong anti-coagulant power of fluoride may be ascribed to the lowest
solubility of the calcium fluoride formed. On the other hand, chloride, bromide
and iodide form calcium salts which are much soluble.

When NaNO₂ or NaNO₃ solution was added in the blood, both react as
a weak anti-coagulant. The effect increases with the decrease of the molecular
weight, $NO_2' > NO_3'$. The solubility of the calcium salt formed by NO_2' is a
little lower than that of NO_3'.

When the blood was diluted more than 1.5 times by M/8 NaHCO₃ or
by M/12 Na₂CO₃ solution, the coagulation was perfectly prevented. Calcium
carbonate is one of the most insoluble salts, but partially changes to calcium
bicarbonate combining with the CO₂ dissolved in the solution as the following
equation

$$CaCO_3 + CO_2 + H_2O \rightleftarrows Ca(HCO_3)_2$$

The equilibrium progresses toward right influenced by the partial pressure of CO_2; the solubility of calcium bicarbonate being about 100 times larger than that of calcium carbonate.

The effect of $M/12$ Na_2HPO_4 or $M/16$ Na_3PO_4 solution is remarkable. When more than one drop is put into 0.12 cc of the blood, the coagulation is perfectly prevented owing to the insolubility of both $CaHPO_4$ and $Ca_3 (PO_4)_2$ formed.

According to the strength of the anti-coagulant power, the inorganic anions except halogen anions may be arranged in the following order of series:

$$HPO_4'' \cdot PO_4''' \gg HCO_3' \cdot CO_3'' \gg NO_2' > NO_3'$$
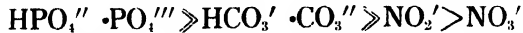
When a drop of Na_2SO_4 solution is added in the blood, the fibrinogen contained changes instantly into a viscous sticky mass and the true coagulation does not occur.

b) Effect of organic anions: The effect of organic sodium salt solutions, $M/8$ sodium formate, sodium acetate, sodium propionate, sodium valerianate; $M/12$ sodium oxalate, sodium succinate, sodium tartrate; $M/16$ sodium citrate were tested under controlled pH near 7.3.

The solubility of the calcium salts formed combining with the fatty acid anions are considerably high, so the anti-coagulant power of the sodium salts added is small. The degree of the anti-coagulant power of them may be roughly proportional to the inverse solubility of their calcium salts, i. e., valerianate' $\gg$ acetate' $>$ propionate' $>$ formate'. The anti-coagulability of valerianate does not precisely follow the degree of solubility of calcium salts formed. The explanation of the fact may be described later.

When the solution of the sodium salts of the dicarboxylic acids, sodium oxalate or sodium succinate was added in the

Fig. 5. Curves showing time of blood coagulation diluted by solutions of various organic anions added (pH 7.3, Temp. 25.3°–32.4°C). ■ $M/8$ sodium formate solution; ▼ $M/8$ sodium acetate solution; □ $M/8$ sodium propionate solution; ▲ $M/8$ sodium valerianate solution; ○ $M/12$ sodium oxalate solution; △ $M/12$ sodium succinate solution; ▽ $M/12$ sodium tartrate solution; ● $M/16$ sodium citrate solution.

blood, a distinct difference appeared between them, the former being the strongest anti-coagulant, while the latter hindered the coagulation insufficiently. The calcium oxalate is one of the most insoluble salts, while the calcium succinate is soluble in distilled water more than 1%.

When the solution of the sodium salt of the dioxydicarboxylic acid or the oxytricarboxylic acid, sodium tartrate or sodium citrate was introduced in the blood, the coagulation of the blood was strongly suspended, since the calcium salts transferred from both of the sodium salts are highly insoluble. The anti-coagulant power of them may be arranged in the order of series,

oxalate″ ≫ citrate‴ > tartrate″ ≫ succinate″

It may be accepted as proved that the organic anions also have an anti-coagulant power more or less according to the inverse solubility of their calcium salts.

Effect of cations

The effect of cations dissociated from the various metal chlorides are quite diverse according to their chemical properties. The alkali metal ions have a weak anti-coagulant power, and the cations of alkali earth metals excluding barium an activation, while the heavy metal ions show a very different effect according to their own properties.
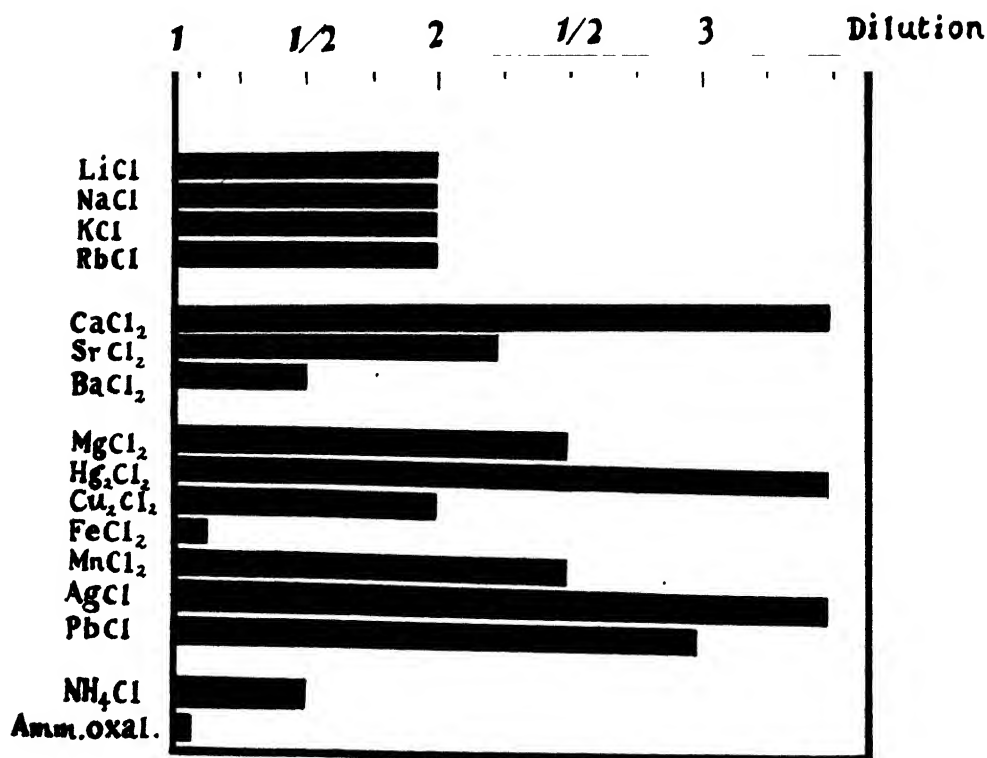
Fig. 6. Limit of coagulation diluted by various metal chloride solutions added.

a) Effect of alkali metal cations: Solutions of alkali metal chlorides M/8 LiCl, NaCl, KCl and RbCl were examined. The cations of alkali metals act as weak anti-coagulants, since the time of the blood coagulation lengthens when these solutions are added. There seems to exist no marked difference between their actions, and the anti-coagulability is quite free from their molecular weights. They may be put into the following order of series: Na·>Rb· ·Li·>K·
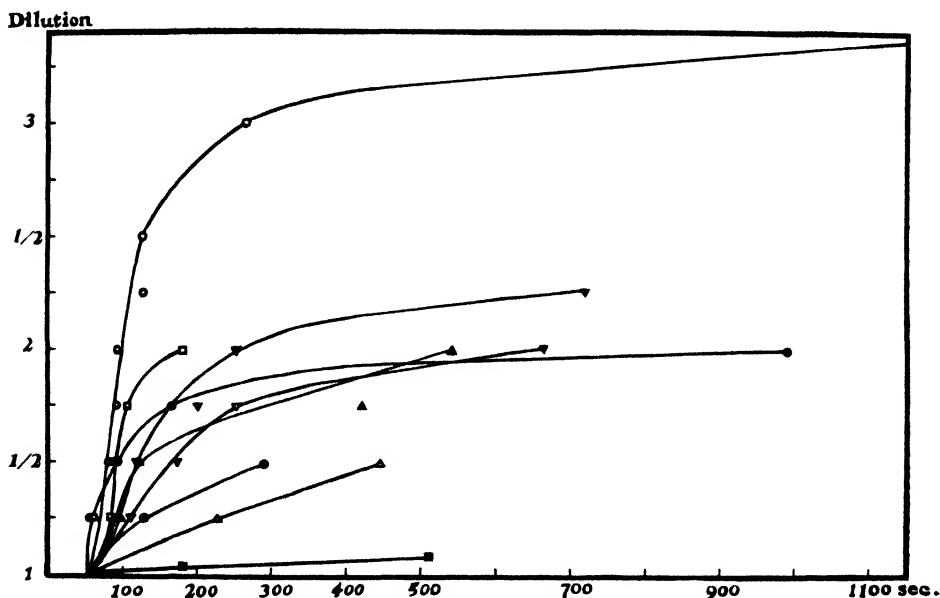
Fig. 7. Curves showing time of coagulation of blood diluted by solutions of various alkali and alkali earth metal cations added (pH 7.3 Temp. 26.6°–31.2°C). ▲ M/8 LiCl solution; ● M/8 NaCl solution; □ M/8 KCl solution; ▽ M/8 RbCl solution; ○ M/12 CaCl₂ solution; ▼ M/12 SrCl₂ solution; ⊙ M/12 BaCl₂ solution; △ M/8 NH₄Cl solution; ■ M/8 ammonium oxalate solution.

b) Effect of alkali earth cations: Solutions of alkali earth metal chlorides, M/12 CaCl₂, SrCl₂ and BaCl₂ were prepared controlling their pH near 7.3.

When the solution of CaCl₂ was introduced into the blood the coagulation was not prevented until it was diluted more than 3.5 times and the white precipitation occured with the increase of the added calcium chloride. The increased coagulability of the blood caused by calcium cannot be substituted by other alkali earth cations.

Strontium ion has shown no conspicuous influence on the coagulation, while barium ion has indicated strong anti-coagulant power. When a little amount of BaCl₂ solution was introduced into the blood, white flocky precipitation appeared. This is presumably BaSO₄, one of the most insoluble salts formed combining with the SO₄″ contained in the blood.

c) Effect of ammonium ion: Ammonium ion has been known having a similar effect with that of alkali metal ions on many biological processes.

When the solution of M/8 NH₄Cl was put into the blood the coagulability of the blood was markedly decreased. The NH₄· has a stronger anti-coagulant power than any other alkali metal cations.

When the solution of M/12 ammonium oxalate, the salt formed combining both the strongest anti-coagulant anion and the cation, was introduced into the blood, there is displayed no stronger anti-coagulant effect than in the case of sodium oxalate.

d) Effect of metal ions: Almost all the solutions of the metal chlorides show a strong acidity caused by hydrolysis. Owing to lower pH than 2.5 of the solutions of $FeCl_6$, $CuCl_2$, $SnCl_2$, $SnCl_4$, $HgCl_2$, $SbCl_3$ and $AlCl_3$ the fibrinogen or other protein factors contained in the blood was instantly transferred into the sticky masses.

Solutions of $CdCl_2$, $CrCl_3$, $ZnCl_2$, $CoCl_2$, and $NiCl_2$ also changed the blood into the viscous masses in spite of their less severe acidities. Adding less than 5 per cent in volume of N/10 NaOH solution into the solutions of M/8 AgCl, PbCl Hg_2Cl_2 and Cu_2Cl_2; M/12 $FeCl_2$ and $MnCl_2$ they were brought near pH 7.3. Also the effect of M/12 $MgCl_2$ was experimented.
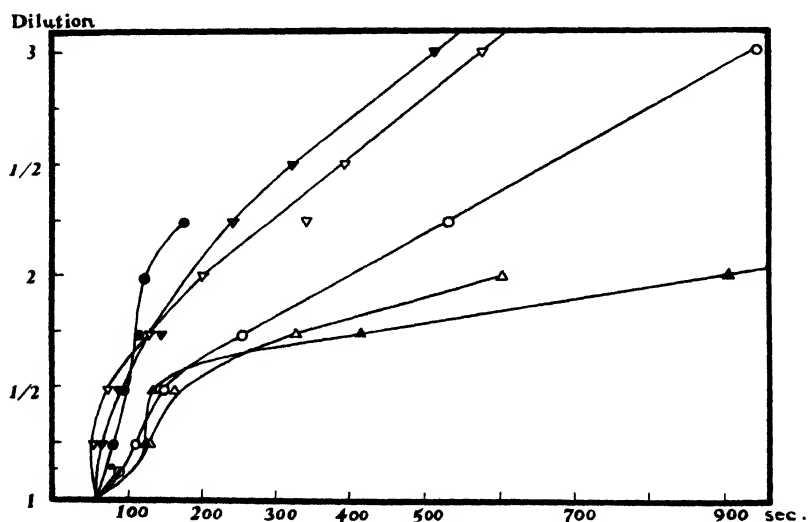
Fig. 8. Curves showing time of dlood coagulation diluted by various metal cations added (pH 7.3 Temp. 26.0° 29.5°C). ∇ M/8 AgCl solution; ○ M/8 PbCl solution; △ M/8 Cu_2Cl_2 solution; ▼ M/8 Hg_2Cl_2 solution; ◉ M/12 $FeCl_2$ solution; ● M/12 $MgCl_2$ solution; ▲ M/12 $MnCl_2$ soluiton.

Generally speaking, the metal ions have an activating power for the coagulation more or less except Fe·· which acts as a strong anti-coagulant. As is shown in Fig. 8 Hg· and Ag· having a strong activating power like that of calcium, while Pb··, Mn·· and Mg·· are the less activators. Cu· showing a slight anti-coagulant power as alkali metal ions.

The degree of anti-coagulant action may be summarised as the following order of series,

$$Hg^{\cdot} \cdot Ag^{\cdot} \gg Pb^{\cdot} > Mn^{\cdot\cdot} > Mg^{\cdot\cdot} > Cu^{\cdot} \gg Fe^{\cdot\cdot}$$
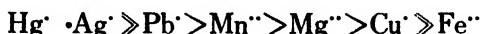
e) Effect of sea water: Sea water is composed of strong activators as $Ca^{\cdot\cdot}$ and $Mg^{\cdot\cdot}$ with weak anti-coagulants as $Na^{\cdot}$, $K^{\cdot}$, Cl' and SO_4''. The total concentration of the salts in sea water is higher than the test solutions of the present experiment, since it corresponds to about 5M/8 NaCl solution.

Sea water (pH 8.25) has a strong power for activating the coagulation (Fig. 9). This may be due to the fact that a slight calcium content suppresses the large amount of the anti-coagulant dissolved in the blood.

Effect of pH

The profound influence of the hydrogen ion upon the blood coagulation has been demonstrated, and the coagulation is said to be relatively resistant to the change of pH of added salt solution.

Solutions of sodium salts with varying pH was obtained by the addition of N/10 HCl or NaOH. When a weak alkaline solution of $NaHCO_3$ (pH 8.25), $NaNO_2$ (pH 9.0) or NaCl (pH 9.0) is added in the blood, the time of coagulation is slightly accelerated and the coagulability also increased (Fig. 9), while the solution of Na_2CO_3 which shows more intense alkalinity (pH 10.0) decreases the coagulability. The action of weak acidic solution is rather conspicuous; the saline solution slightly acidified increases the coagulability much.

It is noticeable that in pure salt solutions, slight change of pH (6.0–9.0) induces the coagulation, while strong alkaline solution (pH 10.0) decreases the coagulability.

Table 5

Effect of pH of various sodium salt solutions on blood coagulation.
Time of coagulation in sec.

Solutions added	pH	Degree of dilution (no. of drops added)				
		$1\frac{1}{4}$ (1 drop)	$1\frac{1}{2}$ (2 drops)	$1\frac{3}{4}$ (3 drops)	2 (4 drops)	$2\frac{1}{4}$ (5 drops)
M/8 NaHCO₃	7.4	86.0	106	—		
	8.25	52.0	97.0	273	—	
M/8 NaCl	6.0	51.0	71.0	75.0	92.0	200
	7.3	54.0	94.5	163	990 ·	—
	9.0	40.0	88.0	123	300	
M/8 NaNO₂	7.4	108	146	360	--	
	8.4	43.0	77.0	120	·	
M/12 Na₂CO₃	7.2	56.0	86.0	—		
	10.0	69.0	127	— ·		

In order to compare the effect of mixed salt solution, the effect of varying pH of sea water was determined. A series of sea water, their pH being from 3.0 to. 11.0 were prepared by the same method described before.

When the change of pH is slight (6.15–8.25), the mode of coagulation is not altered. (Table 6 and Fig. 9). The increase of pH up to 9.6 remarkably decreases the time of coagulation though the coagulability is not affected, while by the decrease of pH down to 3.0, it is markedly increased.

Table   6

Effect of pH of sea water on blood coagulation.
Time of coagulation in sec.

pH	Degree of dilution (no. of drops added)							
	$1\frac{1}{4}$ (1 drop)	$1\frac{1}{2}$ (2 drops)	$1\frac{3}{4}$ (3 drops)	2 (4 drops)	$2\frac{1}{4}$ (5 drops)	$2\frac{1}{2}$ (6 drops)	3 (8 drops)	$3\frac{1}{2}$ (10 drops)
3.0	58.0	115	175	192	310	355	510	1200
6.15	66.0	112	130	194	420	600	- -	—
7.4	93.0	115	147	172	275	530	—	—
8.25	45.0	71.0	74.0	106	255	680	—	..
9.6	43.0	65.0	120	150	170	190	- -	
11.0	40.0	70.0	108	135	165	210	—	-
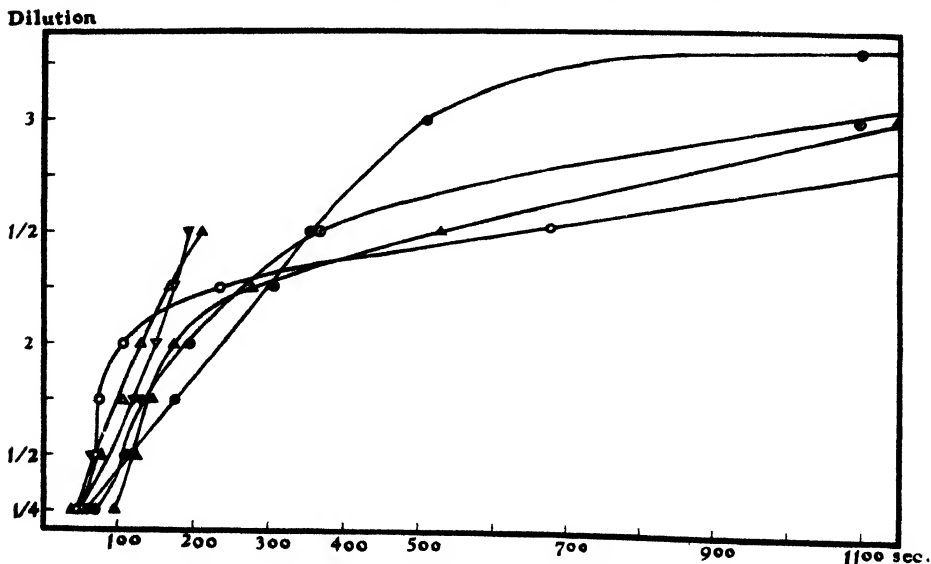
Fig. 9. Curves showing time of blood coagulation caused by varying pH of sea water (Temp. 30.2°–31.5°C). ● for 3.0; ◉ for 6.25; ▲ for 7.3; ○ for 8.25; ▽ for 9.6; △ for 11.0.

Generally speaking, the blood coagulation is not disturbed in the favorable range of acid and alkaline reaction. On the contrary, both the time of coagulation and the coagulability are strongly inhibited out of this range.

Anions

It is made clear in the present study that the prevention of the blood coagulation caused by various sodium salt solutions added is brought forth by the extinction or diminution of the concentration of calcium ions existing in the blood by the formation of insoluble calcium salts, since the concentrations of the solutions added are very low and all of them are the strong electrolytes (more than 80% is ionized).

The anti-coagulant degree of various inorganic anions dissociated from the sodium salts is to be arranged in the following order of series:

$$F' \gg HPO_4'' \cdot PO_4''' \gg HCO_3' \cdot CO_3'' \gg NO_2' > Cl' > Br' > NO_3' \nearrow J'$$
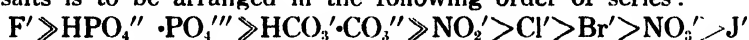
Moreover, simple relation exists between the anti-coagulability of the sodium salts tested and the solubility of the calcium salts formed, as is shown in Table 7 and Fig. 10.

Table   7

Relation between limit of coagulant power of diluted blood by adding various sodium salt solutions and solubility of calcium compounds formed with calcium ion existing in blood of *Ligia exotica*

Sodium salt solutions	Limit of dilution	Formed Calcium compound	Solubility in % at 30°C [1]
M/8 NaF	$1\frac{1}{8}$	CaF_2	18.0×10^{-4}
M/8 NaCl	2	$CaCl_2$	49.9
M/8 NaBr	2	$CaBr_2$	62.5
M/8 NaI	$2\frac{1}{4}$	CaI_2	68.3
M/16 Na₃PO₄	$1\frac{1}{4}$	$Ca_3(PO_4)_2$	36.0×10^{-6}
M/12 Na₂HPO₄	$1\frac{1}{4}$	$CaHPO_4$	23.0×10^{-5}
M/12 Na₂CO₃	$1\frac{1}{2}$	$CaCO_3$ and $Ca(HCO_3)_2$ are coexisted	52.0×10^{-4}
M/8 NaHCO₃	$1\frac{1}{2}$	$Ca(HCO_3)_2$	16.0×10^{-2}
M/8 NaNO₂	$1\frac{3}{4}$	$Ca(NO_2)_2$	47.0
M/8 NaNO₃	2	$Ca(NO_3)_2$	59.4
M/8 Na-form.	$2\frac{1}{4}$	Ca-form.	16.8

[1] Interpolated values from Randolt-Bernstein's chemical table.

M/8 Na-acet.	$1\frac{3}{4}$	Ca-acet.	33.8
M/8 Na-prop.	2	Ca-prop.	39.1
M/8 Na-n-val.	$1\frac{1}{4}$	Ca-val.	84.0×10^{-1}
M/12 Na-oxal.	$1\frac{1}{16}$	Ca-oxal.	63.0×10^{-5}
M/12 Na-succ.	$2\frac{1}{4}$	Ca-succ.	12.5×10^{-1}
M/12 Na-tart.	$1\frac{1}{2}$	Ca-tart.	44.0×10^{-5}
M/16 Na-cit.	$1\frac{1}{4}$	Ca-cit.	96.0×10^{-5}
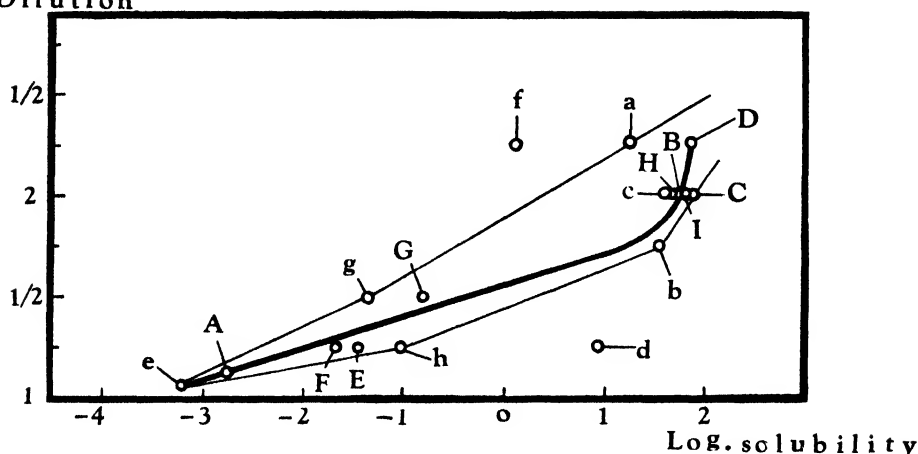
Fig. 10. Relation between anti-coagulant action of various anions dissociated from sodium salts and log. per cent solubility of formed calcium compounds.
A, F'; B, Cl'; C, Br'; D, I'; E, PO$_4$'''; F, HPO$_4$''; G, HCO$_3$'; H, NO$_2$'; I, NO$_3$'; a, formate'; b, acetate'; c, propionate'; d, valerianate'; e, oxalate''; f, succinate''; g, tartrate''; h, citrate'''.

The anti-coagulant effect of various organic anions tested as the sodium salts may be put into the following order:

oxalate'' ≫ citrate'''·valerianate' ≫ tartrate'' ≫ acetate' > propionate' > succinate'' > formate'
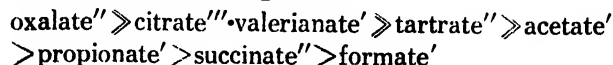
The anti-coagulability of the sodium salts combined with organic anions is also inversely proportional to the solubility of the formed calcium compound excluding a few cases.

As is shown in Fig. 10, the limit of coagulant power of the diluted blood by the addition of the various sodium salt solutions is plotted against the log. solubility of the formed calcium compounds with the calcium ion existing in the blood, where sodium valerianate shows stronger anti-coagulant power than

the insolubility of its calcium salts, while the relation is reversed in the case of sodium succinate.

A similar case was explained by Loeb ('22) in his experiment of contact irritability in muscle. He states that it is due to presence of free HO ions that solution of sodium valerianate gives rise to a slight degree of contact irritability in muscle, although calcium valerianate is soluble. If we diminish the alkalinity of a sodium valerianate solution by adding a small amount of free valerianic acid, it no longer produces the contact irritability in muscle.

In the present case, however, the condition differs slightly and the above explanation cannot be applied, since the pH of the solution used is always 7.3 throughout the observation.

When sodium salts whose anions being strong calcium precipitants are added in the blood, there occurs a white precipitant instantly. This was affirmed as the calcium salts by analyses of Kramer and Tisdall's method ('21).

As is shown in Table 8, sodium valerianate also calls upon the strong precipitation in spite of the high solubility of the calcium valerianate. This may be explained by the change of the calcium content of the blood before and after coagulation on which my later study will refer.

The graphical illustration of Fig. 10 shows that the relation between the anti-coagulability of anions derived from various sodium salts added and the log. per cent solubility of the calcium compound formed in the blood is almost rectilinear so far as the small amount of strong anti-coagulant solution is concerned, while the weak anti-coagulant action of the distilled water has buffer action, when the large amount of weak anti-coagulant solution is introduced.

Table 8

Formation of calcium precipitate in blood after various sodium salt solutions were added

(pH 7.3, Temp. 25.0°C)

Sodium salt solutions	Formation of calcium precipitate
M/8 NaF	++
M/8 NaCl	—
M/8 NaBr	—
M/8 NaI	—
M/16 Na_3PO_4	+
M/12 Na_2HPO_1	+
M/12 Na_2CO_3	—
M/8 $NaHCO_3$	—
M/8 $NaNO_2$	—
M/8 $NaNO_3$	—
M/8 Na-form.	±
M/8 Na-acet.	—
M/8 Na-prop.	—
M/8 Na-val.	+
M/12 Na-oxal.	++
M/12 Na-succ.	—
M/12 Na-tart.	—
M/16 Na-cit.	—

Cations

It is a well known fact in biology that the alkali metal ions have an antagonistic action against the alkali earth ions and it is also true in the blood coagulation, since the increase of the alkali metal ions in the blood causes a slight decrease of coagulability. But the anti-coagulant action quite differs

from that of calcium precipitant anions. The anti-coagulant power of alkali metal cations against calcium ion is due to the antagonistic action between them not precipitating the latter. This may be cleared by the addition of ammonium oxalate solution into the blood where the strong antagonistic action of NH_4 and the anti-coagulant action of oxalate'' do not act in the same manner and the anti-coagulability is not superior to the effect of sodium oxalate.

When calcium is put into the blood, supersaturation of it occurs in the blood and the superfluous calcium begins to precipitate, so the limit of coagulation is largest suppressing the anti-coagulant effect of dilution. According to Stuber and Sano ('21), Sr·· can bring the oxalated calcium-free blood to coagulation, while Ba·· and Mg·· can not. They arranged the coagulant power of divalent cations for the oxalated blood as follows: Ca··>Sr··>Ba··=Mg·· and concluded that the capacity of inducing coagulation is inversely proportional to the solubility of the formed alkali earth oxalates.

In the present investigation, however, the effect of strontium for the blood coagulation is quite indifferent; it does not show any anti- or activating power for coagulation, while a drop of barium solution introduced into the blood produces a white precipitate of $BaSO_4$ and the blood coagulation is prevented intensely.

The rôle of calcium in the blood coagulation is unique and cannot be substituted by any other cations. According to the experiment of Stuber and Sano, the action of Sr··, Ba·· and Mg·· for the oxalated blood has no effect on Ca·· but on oxalate'' coexisting in the blood, so the coagulability has a contact relation with the solubility of formed alkali earth oxalate.

Meanwhile, Loeb ('07) states that the coagulation of the diluted blood of *Hummerus* is called upon by adding $SrCl_2$ or $BaCl_2$ instead of $CaCl_2$, while $MgCl_2$ and alkali metal chlorides can not. In the present study, however, no particular effect is observed when Sr·· is introduced into the blood where Ca·· is contained normally. On the other hand, the breaking down of the ionic balance by severe precipitation of $BaSO_4$ after Ba·· is added, may cause some disturbance on the coagulating process.

Fischer and Schmitz ('33) states that incoagulable blood after being treated by N/10 potassium oxalate, is induced to coagulate by adding $CaCl_2$, while it can not be coagulated by the addition of an equivalent amount of $AgNO_3$. Ca·· can not be replaced by Ag·· in the oxalated blood. On the other hand a small amount of $AgNO_3$ can induce the heparinized incoagulable blood to coagulate instantly. So they concluded that normal ions have influence over the anti-coagulant action of heparin and not on the blood component itself. They arranged metal ions in a series according to their anti-heparin effect as follows:

Hg>Ag>Cu>Au>Cd>Mg>Pt>Zn>Co>Ca>Ba>Fe···Fe···Al ·Mn
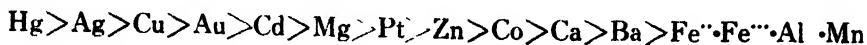
Generally speaking, the metal ions behave as an activator on the coagulation in the blood of *Ligia* where normal amount of Ca·· exists. When the blood is diluted by the metal chloride solutions, the insufficiency of Ca·· may

be compensated by the metal ions and the blood coagulation is attained successively. $Mg^{..}$, the indispensable factor of sea water can also activate the coagulability of the blood markedly. The degree of the activating power may be arranged in the following order of series, $Hg^{.} \cdot Ag^{.} \gg Pb^{.} > Mn^{..} > Mg^{..} > Cu^{.} > Fe^{..}$. This series shows quite an exact coincidence with Fischer's.

<div align="center">IV</div>

Anti-coagulant Action of the Hepato-pancreas of *Ligia exotica*

A blackish brown fluid obtained after the autolysis of the hepato-pancreas of *Ligia exotica* shows a strong anti-coagulant power for the blood of not only its own species but other crustaceans also. In the present chapter, a part of the physiological effect displayed by the fluid is dealt with.

Two pairs of yellowish brown tubular hepato-pancreas occupies the coelomic space of *Ligia exotica*. When the animal is dissected and the organ is exposed in the air, it begins to autolize. The organ is also changed into the fluid in situ soon after the death of the animal.

Hepato-pancreas dissected out is ground in the bowl and filtered by the cloth. Instead of this procedure, free autolysis during a day or two perfectly liquefies the organ. The filrate thus obtained is a viscous blackish brown fluid with metallic luster which shows no change after the elapse of a year in the laboratory. The filtrate will be called under the name of " hepato-pancreatic fluid " in the present paper.

Properties of the hepato-pancreatic fluid

The specific gravity of the hepato-pancreatic fluid thus prepared is measured by using the specific bottle of 55 cc capacity. The average value of 5 measurements is 1.0871 at 18°C.

The freezing point of the fluid is determined by Beckmann's thermometer graduated up to 0.01°C. The average value of 5 measurements is −8.42°C. The cooling curve of the fluid after immersion in the cooling mixture of ice and water e. i. ca −10.5°C, is shown in Fig. 11. The gradual transformation of the fluid into ice and the extremely low freezing point might suggest that the larger part of the solvent being the oily solution and not the water.

The pH of the fluid is determined potentiometrically using the hydrogen ion meter with antimon electrode manufactured by Yokogawa Denkiseisakusho Ltd. The full description of the apparatus may appear in a later paper. The pH of the hepato-pancreatic fluid differs according to the procedure of preparation; the average value of the fluid prepared by grinding the crude hepato-pancreas is 5.75, while that of those obtained by the perfect autolysis after the elapse of 24 hours shows 4.18.

In the present experiment, the fluid obtained by free autolysis only is used.

Hydrolysis with dilute mineral acids as hydrochloric, nitric and sulfuric
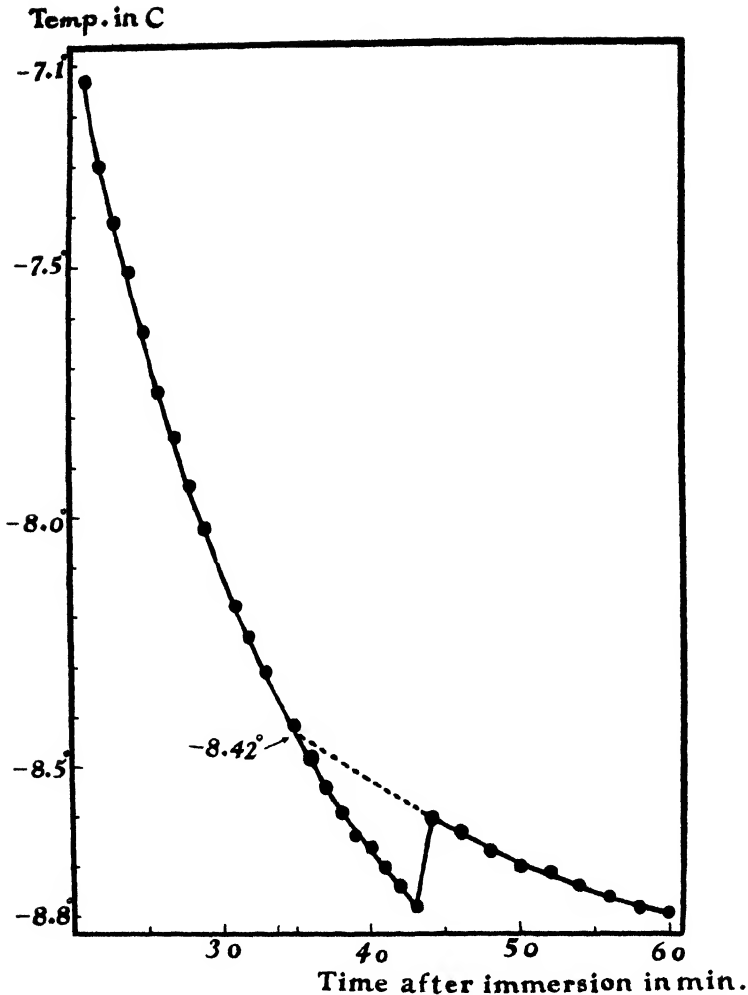
Fig. 11. Cooling curve of hepato-pancreatic fluid after immersion in –10.5°C water. Freezing point is determined graphically as –8.42°C.

destroys the anti-coagulant action, while with dilute alkali no prevention of it occurs.

Coagulant action of the hepato-pancreatic fluid

One drop (0.03 cc) of 1/10 hepato-pancreatic fluid (1 part of the fluid is diluted by 9 parts of the distilled water) can suspend the coagulation of ten drops of blood, while one drop of 1/100 fluid being sufficient to retard the time of coagulation of four drops of blood. The power of preventing the blood coagulation is of the order of 1 to 100, while 1 to 400 for retarding the time of coagulation. The anti-coagulant action is almost the same order

with that of sodium oxalate, the strongest anti-coagulant (see elsewhere).

Hepato-pancreatic fluid is effective also in vivo as in vitro. When 0.01 cc of the fluid is injected intraperitoneally into normal *Ligia* of the largest male, the blood obtained from it is rendered wholly incoagulable for a period of about half an hour. Specimens withdrawn after this time has shown imperfect clotting in an hour.

The hepato-pancreatic fluid of *Ligia* can prevent the blood coagulation of other crustacea though the action is much diminished. The blood of the common shore crabs, *Xanthodius distinguendus, Sesarma dehaani, S. haematocheir* and *Panulirus japonicus* is clotted by the addition of a small amount of the hepato-pancreatic fluid of *Ligia*. Also the blood of *Ligia* can be coagulated by the extract of their hepato-pancreas when introduced. While, the blood of the Japanese giant crab, *Macrocheira Kaempferi* can never be coagulated by the added hepato-pancreatic fluid and the blood of *Ligia* also remains incoagulable by the hepato-pancreatic extract of the crab. The anti-coagulant action of the hepato-pancreatic fluid on the blood of fishes such as *Lateolabrax japonicus, Girella punctata* and *Mugil cephalus* and the blood incoagulability of *Ligia* caused by the liver extract of the fishes was quite vague as is shown in Table 9.

Table 9

Specificity of hepato-pancreatic fluid of *Ligia exotica*

Materials used	Anti-coagulant power of hepato-pancreatic fluid of *Ligia exotica*	Blood incoagulability of *Ligia exotica* by extract of hepato-pancreas or liver
Crustacea		
Xanthodius distinguendus	++	+
Sesarma dehaani	++	+
S. haematocheir	++	+
Macrocheira Kaempferi	—	—
Panulirus japonicus	++	+
Pisces		
Lateolabrax japonicus	±	±
Girella punctata	±	±
Mugil caphalus	±	±

The anti-coagulant action of the hepato-pancreatic fluid is not destroyed by prolonged boiling, while 1/10 fluid is affected more or less by temperature as is shown in Table 10.

The anti-coagulant power of 1/10 fluid is diminished about one half after 20 minutes boiling. Treatment of the fluid at 64°C for 30 minutes and at 55°C for an hour also decreases the anti-coagulant power slightly, while an hour's cooling at -15°C can not destroy the power notwithstanding the fluid is perfectly frozen.

Table 10

Effect of temperature on anti-coagulant action of 1/10 hepato-pancreatic fluid

Treatment	Time of coagulation in min. (one drop of 1/10 fluid is introduced in diff. amount of blood)				
	6 drops	8 drops	10 drops	15 drops	20 drops
Control at 30.4°C.			—	6.25	4.5
Boiled 20 min.	—	10.5	7.5		
30 min. at 64°C.			6.5		
An hour at 55°C.			3.3	2.3	
An hour at –15°C.				9.0	5.5

Adding one drop of the hepato-pancreatic fluid diluted between 50–10000 times in four drops of the blood, the optimum temperature for action and the limit of dilution of the hepato-pancreatic fluid is determined.

Table 11

Optimum temperature for the action and the limit of dilution of hepato-pancreatic fluid

Time of coagulation in sec.

Temperature \ Dilution	1/50	1/100	1/500	1/1000	1/5000	1/10000
5°	345.0	205.0	160.0	145.0	145.0	147.0
15°	230.0	165.0	140.0	133.5	120.0	116.5
25°	227.5	134.0	126.0	120.0	110.0	116.5
35°	102.5	74.0	71.0	68.0	66.5	67.0
40°	—	183.5	170.0	145.0	146.5	140.0
45°	—	—	—	—	—	—

As is shown in Table 11, the blood at 45°C does not coagulate owing to the weak resistant power against temperature. The anti-coagulant action of the hepato-pancreatic fluid is maximum between 15–25°C, since 1/1000 fluid can prolong the coagulation considerably despite the fact that the effect of temperature on the coagulation is minimum at 35°C. The concentration effect of the fluid does not appear at 35°C, while it is remarkable at 5°C (Fig. 12).
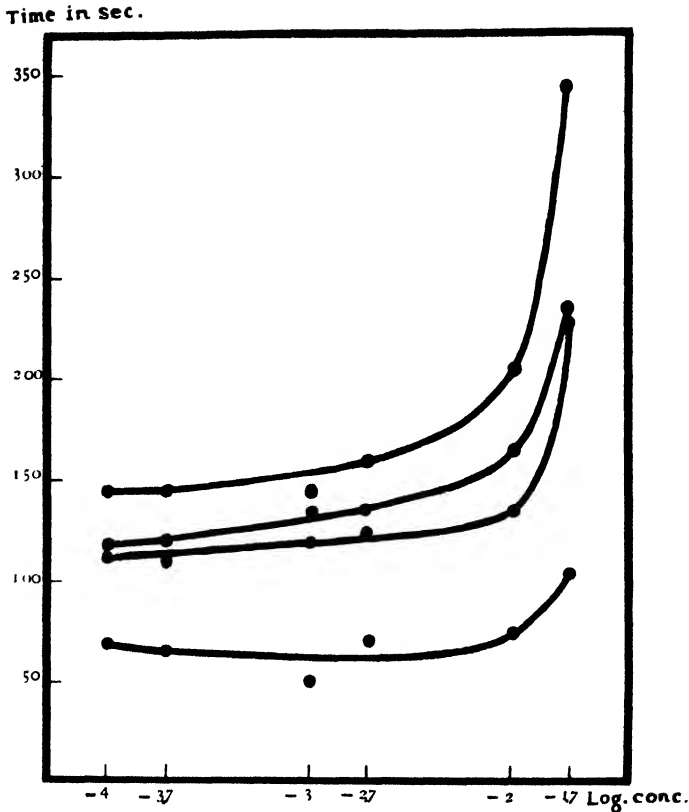
Fig. 12. Concentration effect of hepato-pancreatic fluid on anti-coagulant action at different temperatures. Upper at 5°; upper middle at 15°; lower middle at 25°; lower at 35°C respectively.

Antagonistic Action between Calcium and Hepato-pancreatic Fluid

When different number of drops (one drop=0.03 cc) of M/12 CaCl$_2$ solution is added with one drop of 1/50 hepato-pancreatic fluid into four drops of

Table   12

Antagonistic action between hepato-pancreatic fluid and calcium chloride solution at 30°C

Concentration of hepato-pancreatic fluid (1 drop)	Time of coagulation in sec. Drops of M/12 CaCl$_2$ solution added in 4 drops of blood plus 1 drop of hepato-pancreatic fluid			
	1 drop	2 drops	3 drops	4 drops
1/50	—	—	—	—
1/100	73.0	70.0	89.0	135

the blood, no clotting is induced as is shown in Table 12, while CaCl₂ with 1/100 fluid brings about strong coagulation in a short time. Comparing these results with Table 11, it may be concluded that the coagulant action of calcium is wholly suppressed by the anti-coagulant action of the hepato-pancreatic fluid.

Anti-coagulability of hirudin and heparin for the blood of *Ligia*

a) Anti-coagulant action of heparin: Heparin powder of Kahlbaum is dissolved by distilled water. One drop of 0.5% heparin solution added into four drops of the blood, retards the time of coagulation remarkably, while 1% solution keeps the blood perfectly incoagulable. The degree of the anti-coagulant action is of the order of 1 : 400. For the sake of comparison it is here noted that according to Howell ('22), the anti-coagulant action of heparin for human blood is of the order of 1 mg to 100 cc (1 : 100000).

b) Anti-coagulant action of hirudin: Hirudin solution is prepared dissolving hirudin powder of Kahlbaum by distilled water. The blood of *Ligia* is made incoagulable by 1% solution, the anti-coagulant power is of the order of 1 : 400.

Anti-coagulant substance

In the present study, the properties of the anti-coagulant substance contained in the hepato-pancreatic fluid is determined, but judging from the physiological reaction displayed therein, it may be quite an analogous substance with heparin extracted from the dog liver by Howell ('22).

Fig. 13 Photograph showing normal blood coagulation (left) and incoagulated blood by addition of hepato-pancreatic fluid (right). ×600

According to Bancroft and others ('35), heparin likewise hirudin seems to be an anti-thrombin. It may be inferred at least from the present investigation that the anti-coagulant action of the hepato-pancreatic fluid is not attributable to the calcium precipitant action, since no precipitate was formed during the process.

When incoagulated blood by the hepato-pancreatic fluid is observed under

the microscope, remarkable difference is seen from that of normal clotting as is shown in Fig. 13.

An explosive cell which, as described by Tait ('20), is presumed to set free thrombin or such coagulant is never formed in the heparinized blood.

SUMMARY

1) The mode of blood coagulation of *Ligia exotica* adapted at different temperatures, 10°, 20° and 30°C differs slightly from each other. But all the temperature coagulation curves drawn are caternary in shapes having optimum temperatures for action near 35°C, while the temperature viscosity curve plotted under the same condition denotes quite an antagonistic expression. The effect of the external factors as electrolytes and water contents of the blood and the limit of temperature for coagulation reveal clearly that the precess of the coagulation is more or less induced by the coagulant enzyme contained in the blood.

The variability of the temperature coefficients Q_{10} and μ of the blood coagulation shows the complicity of the process involved, but the unique applicability of b of Bělehrádek's equation suggests that the process has some correlation with the physical changes.

2) The blood coagulation of *Ligia exotica* is inhibited when it is diluted more than 2.5 times by buffered distilled water (pH 7.3).

3) The anti-coagulant action of the anions may be caused by the diminution or extinction of the concentration of calcium ions existing in the blood forming insoluble calcium salts.

The degree of the anti-coagulant power of various inorganic anions dissociated from sodium salts is arranged in the following order of series:

$$F' \gg HPO_4'' \cdot PO_4''' \gg HCO_3' \cdot CO_3'' \gg NO_2' > Cl' > Br' > NO_3' > J'$$
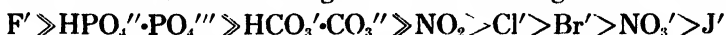
The anti-coagulant action of the organic anions examined as the sodium salts may be put in the following arrangement:

oxalate$'' \gg$ citrate$''' \cdot$ valerianate$' \gg$ tartrate$'' >$ acetate$' >$ propionate$'$
$>$ succinate$'' >$ formate$'$
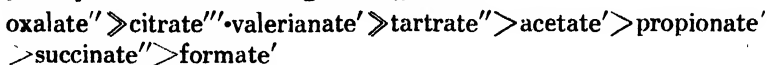
The relation between the anti-coagulability of the anions derived from sodium salts and the log. per cent solubility of the calcium compounds formed in the blood is almost rectilinear.

4) When sodium salts whose anions are strong calcium precipitants are added in the blood, there occurs instantly a white precipitate which is affirmed as the calcium compound by analysis.

5) The anti-coagulant action of the alkali metal cations quite differs from that of the calcium precipitant anions. The anti-coagulant action of the former is, perhaps, due to the antagonistic action against calcium not precipitating it. The alkali earth cations on the other hand have an activating action more or less excluding Ba, which acts as a strong anti-coagulant precipitating SO_4'' forming an insoluble $BaSO_4$. The anti-coagulant power of the alkali and alkali

earth cations may be arraged in the following manner:

$$Ba\cdots > Na \cdot > Rb \cdot \ \cdot Li \cdot > K \cdot > Sr \cdots > Ca \cdots$$

6) Metal ions behave as strong coagulants except Cu˙ and Fe¨, since the blood coagulability is increased by the addition of these ions compensating the insufficient effect of the calcium. Mg¨, a component of the sea water also activates the coagulability of the blood remarkably. The degree of the activating power may be arranged in the following series: Hg˙·Ag˙ ≫ Pb˙ > Mn¨ > Mg¨ > Cu¨ > Fe¨. This series shows an exact coincidence with Fischer's.

7) It is noted in the pure sodium salt solutions that the slight change of pH (6.0–9.0) increases the coagulant power, while strong alkaline (pH 10.0) decreases the coagulability. The blood coagulation is not disturbed in the range of pH 6.15–8.25 of the sea water, while both the time of coagulation and the coagulant power of the blood are strongly inhibited out of this range.

8) Blackish brown fluid is obtained by the autolysis of the hepato-pancreas of *Ligia exotica*. The specific gravity of the hepato-pancreatic fluid is 1.0871 at 18°C, the freezing point is −8.42°C, the value of pH after perfect autolysis is determined as 4.18 potentiometrically by using the hydrogen ion meter with antimon electrode. Hydrolysis with dilute mineral acids destroys the anti-coagulant action, while with alkali no prevention occurs.

9) The anti-coagulant power of the fluid is of the order of 1 to 100, while 1 to 400 for retarding the time of coagulation. The hepato-pancreatic fluid is effective also in vivo as in vitro. The anti-coagulant action of the fluid is effective on the common shore crabs and reciprocally the blood of *Ligia* is coagulable by the extract of their hepato-pancreas, while the fact is not seen on the Japanese giant crab. The anti-coagulant action of the fluid on the blood of fishes and the blood incoagulability of *Ligia* caused by their liver extract is quite vague. The anti-coagulant action of the hepato-pancreatic fluid is not destroyed by prolonged boiling, while 1/10 fluid is affected more or less by temperature above 55°C. An hour's cooling at −15°C does not disturb the anti-coagulant action.

10) The coagulant action of one to four drops of M/12 CaCl₂ introduced into four drops of the blood is wholly suppressed by the anti-coagulant action of one drop of 1/50 hepato-pancreatic fluid. The degree of the anti-coagulant action of heparin and hirudin for the blood of *Ligia* is of the order of 1 to 400, while that for human blood is of the order of 1 to 100000.

11) Microscopical observation has shown that an explosive cell of Tait is never formed in the incoagulable blood of *Ligia* by the addition of the hepato-pancreatic fluid.   December 10, 1937

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Abstracts

1. On the Asymmetrical Growth in the Shell of *Sanguinolaria olivacea* Jay. Ekitaro NOMURA. [Sci. Rep. Tôhoku Imp. Univ., Ser. VI (Biol.), 8, No. 2 (1933), 143–150.] — In specimens shorter than 6.3 mm in length (antero-posterior), the left and right valves are formed symmetrically, but in those longer than 6.3 mm the depth of the left valve becomes deeper than that of the right, and in those longer than 13.5 mm the height (dorso-ventral) of the right valve becomes lower than that of the left. Author.

2. On the Cytoplasmic Framework of the Plasmodium, *Physarum polycephalum*. A. R. MOORE. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 3 (1933), 189–192.] — Studies on the physical structure of the plasmodium, *Physarum polycephalum*, have shown that the living material can creep through the pores of a parchment paper dialyzing thimble, but if forced by pressing and squeezing through a cloth sieve having pores of less than 0.25 mm in diameter it is always killed. Since the pores of the parchment paper have an average diameter of 5×10^{-5} mm and the pores of the cloth sieve are 5000 times that wide, it is concluded that the plasmodium has thread-shaped elements essential to its life, and that the length of such threads is approximately 5000 times the diameter. Author.

3. On the rôle of the Brain and Cephalic Nerves in the Swimming and Righting Movements of the Polyclad Worm, *Planocera reticulata*. A. R. MOORE. [Sci. Rep. Tôhoku Imp. Univ., Ser. VI (Biol.), 8, No. 3 (1933), 193–200.] — In *Planocera reticulata* the brain and seven pairs of cephalic nerves may be seen on ventral view. The anterior and lateral nerves, i–vi, are essential to righting and possibly also to balancing in swimming. In righting some of the impulses which reach the brain by these nerves are converted into inhibitions for the activity of the posterior half of the body. The pair of vii cephalic nerves are concerned with the swimming rhythm; if one is severed the corresponding posterior part of the body loses its power of making swimming movements. Since the swimming impulses originate at the anterior end they may reach the pair vii either through the brain or through the nerve reticulum laterally. The nerve reticulum alone is adequate to mediate dorsal and ventral reflexes. The brain functions as an amplifier of impulses in such a way as to maintain the neuromuscular mechanism is in a state of delicate sensitivity. With the loss of the brain the threshold of reactions is raised throughout the system and the body is quiescent except when subjected to strong stimulation, or has its sensitivity restored by phenol. In the latter case the decapitated worm shows the same spontaneity and makes the same swimming movements as the normal animal in the same solution. Author.

4. On Function and Chemical Differentiation in the Nervous System of *Coeloplana bockii*. A. R. MOORE. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 3 (1933), 201–204.] — Experiments with specimens of *Coeloplana* show that, in righting, the ventral surface is positively stereotropic, and that contact on the dorsal side has a kinetic effect. If a resting animal is touched on its body margin, there is progressive withdrawal at that point, both ipsolateral and contralateral margins moving away. In strychninized specimens stimulation of a margin results in both margins moving centralward; the contralateral response thus shows a reversal of reaction under strychnine. Strychninized animals show opisthotonus in spasm. In addition to strychnine, atropine, nicotine and phenol also produce spasms. In chemical sensitivity the neurones of *Coeloplana* resemble those of echinoderms and worms rather than those of coelenterates. Structurally the nervous system of *Coeloplana* is disposed like that of coelenterates, and therefore in this case morphological complexity does not go hand in hand with chemical differentiation. Author.

5. The Relative Values of Cations in Protecting the Membrane Forming Capacity of the Eggs of the Echinoids, *Clypeaster japonicus* and *Temnopleurus hardwickii*. A. R. MOORE. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 3 (1933), 249–254.] — In the

case of the eggs of *Clypeaster japonicus* and *Temnopleurus hardwickii*, the general property of unfertilized eggs of echinoderms in which they lose irreversibly, in a solution of non-electrolyte, their power to form fertilization membranes, was made use to test the protective action of cations of different valences. The results showed that the divalent alkaline earth metals are approximately 42 times as effective as the monovalent alkali metal ions. Ca^{++} proved to be consistently slightly more effective than Mg^{++}. The series of cobaltamine chlorides as used by Lucké and McCutcheon gave no protection in the case of the 1-valent salt. Beginning with the 2-valent cobaltamine there was found to be an increasing effect by irregular steps with each added valence. The highest coefficient was found between the 2- and 3-valent, the least between the 3- and 4-valent salts. Author.

6. Relation between the Weight, Volume and Linear Dimensions in *Meretrix meretrix* (L.).

Ikusô HAMAI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 2 (1934), 205-212.] In the shells of *Meretrix meretrix*, the following relations are approximately true when K and ε are constant respectively:

$$\text{Weight or Volume} = K_1 \times \text{depth}^\varepsilon \times \text{height} \times \text{length}$$
$$= K_2 \times \text{depth} \times \text{height}^\varepsilon \times \text{length}$$
$$= K_3 \times \text{depth} \times \text{height} \times \text{length}^\varepsilon$$

Author.

7. On the Local Variation in the Shell of *Meretrix meretrix* (L.), with Special Reference to the Growth of Organism.

Ikusô HAMAI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 2 (1934), 131-158.] — In *Meretrix meretrix*, the height, depth, and the shell-weight are respectively greatest in proportion to the same length at an annual average surface temperature of sea-water of about 17.6°C. At this temperature the clam is comparatively round-shaped. The lower the temperature the more marked the anterior projection becomes, and the higher the temperature the more acute the posterior projection. Author.

8. On the Growth of the Shell of *Meretrix meretrix*, especially with regard to Periodicity of Growth relatively to the Seasonal Variation in the Environment.

Ikusô HAMAI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 4 (1935), 339-372.] — The present writer studied in the case of *Meretrix meretrix*, the relation between the time and the growth, and the relative growth rate and its ratio, and found that the natural growth can be expressed by the so called logistic curve of Robertson, and that in the formula, $y = ax^b$, the constant b is the ratio between two conditional growth constants or between two relative growth rates, at the same time phase on each cycle of growth. In his study of the periodicity of the shell growth it has been confirmed that there are two growth periods, *viz.* the spring-autumn period from February to August and the autumn-winter period from August to February. Moreover, he studied the probable relation between the ratio of relative growth rate and the temperature or the salinity and found that the ratio between weight and length shows the maximum value to exist at a temperature of about 26.2°C. Author.

9. On the Histogenesis of the Islands of Langerhans in *Rana japonica* (Günther).

Kunio HIRATA. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 2 (1934), 159-182.] — The primary island cells, which have differentiated a few days after hatching, gradually proliferate and form the primary islands, most of which differentiate further into the secondary islands. Some of the primary island cells are differentiated also into the fuchsinophile island cells. Author.

10. On the Relation of the Daily Period to the Sexual Maturity and to the Moulting of *Zosterops palpebrosa japonica*.

Hoshimaro MIYAZAKI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 2 (1934) 183-204.] — The present writer has succeeded in causing the sexual maturity and the moulting of *Zosterops palpebrosa japonica* to repeat three times a year by means of "Yogai". He concludes that, without regard to temperature, feeding period, and to their muscular exercise, a prolongation of the daily light period causes an acceleration of the sexual development towards maturity, and a shortening of this period an acceleration of the moulting. Author.

11. **Some Notes on *Musculium heterodon* (Pilsbry), a Fresh-water Bivalve. II. The Gill, the Breeding Habits and the Marsupial Sac.** Katsuhiro OKADA. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 4 (1934-1935), 373-392.] — The structure of the gill, the structure and development of the marsupial sac, the breeding habits, and the nutrition-process of the embryos of *Musculium heterodon* are mentioned in this paper. Moreover, the writer adds a discussion of the origin of the inner layer of the marsupial sac, and maintains that this layer as well as the nutriment layer of the inner branchial chamber originate from the blood corpuscles of the parent mussel. Author.

12. **Some Notes on *Musculium heterodon* (Pilsbry), a Freshwater Bivalve. III. Fertilization and Segmentation.** Katsuhiro OKADA. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 10, No. 3 (1935), 467-484] — The entrance of the sperm occurs in proximity to the urinogenital orifice, and the maturation division of the ova begins after its entrance and the arrival on the floor of the inner branchial chamber. The cleavage has been definitely traced to the twenty-seven-cell stage. Author.

13. **Notes on the Relation between the Moulting, the Sexual Maturation and the Light Period in *Zosterops palpebrosa japonica*.** Hoshimaro MIYAZAKI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, No. 4 (1935), 427-430.] - The prolongation of the light period makes the moulting prolonged and indistinct. Author.

14. **A Study of One Case in which Different Environmental Conditions Produce Different Types of *Meretrix meretrix*.** Ikusô HAMAI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 10, No 3 (1935), 485-498.] The roundish type grows in a calm sea with a slightly muddy bottom, the elongated type on a sandy shore facing open sea. Several environmental conditions of different habitats are compared. Author.

15. **Report on the Calcareous Sponges Obtained by the Survey of the Continental Shelf Bordering on Japan.** Sanji HÔZAWA. [Sci Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 1 (1933), 1-20. 1 pl., 4 text-figs.] - Specimens collected by the survey undertaken by the Imperial Fisheries Institute of Tokyo, 1922 to 1930, thirteen in number, representing 8 species belonging to 5 genera and 3 families are described. The following four new species were established: *Leucosolenia soyo, Grantia glabra, G. kujiensis,* and *Leucandra yuriagensis.* Shichiroku Nomura.

16. **Contributions to the Physiology of the Heart of Oyster. IV. The Action of Adrenaline on the Isolated Heart of Oyster.** Shun-ichi TAKATSUKI. [Sci. Rep., Tôhoku Imp Univ., Ser. IV (Biol.), 8, No. 1 (1933), 21-29, 6 text-figs.] — Adrenaline accelerates the pulsation and increases the tone of the heart muscle. The minimum effective concentration is as follows: 300 cc sea-water+1/1000 adrenaline chloride 0.5 cc. Shichiroku Nomura.

17. **Notes on the Anatomy of the Young of *Caudina chilensis* (J. Müller).** Yôzô KITAO. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV (Biol.) 8, No. 1 (1933), 43-63, 2 pls., 31 text-figs.] - Fresh materials could easily and abundantly been obtained by the present author, either in adult form or in young and larval forms in the vicinity of the Marine Biological Laboratory of Asamushi. Many points in the morphology of the young of the holothurian, that had remained obscure, were elucidated. Shichiroku Nomura

18. **Contributions to the Physiology of the Ascaris. 1. Glycogen Content of the Ascaris, *Ascaris megalocephala* Cloq.** Yoshiyuki TORYU. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 1 (1933), 65-74. 1 pl., 1 text-fig.] - Micro-analytical and histochemical methods were applied. The female contains a greater amount of glycogen than the male: 3.8% of the fresh weight and 23% of dry matter in the female, and 2.9% of fresh weight and 15% of dry matter in the male. The adult female contains greater amount of glycogen than the young. The greatest amount of glycogen is stored in the non-contractile substance of the muscle cells, amounting to about 70% of the total glycogen in the female and 95% in the male, while the

contractile substance of the muscle cells contains no glycogen. Female reproductive system contains 20% of the total glycogen, while the male reproductive system contains a smaller amount. No seasonal variation of glycogen content was observed. Shichiroku Nomura.

19. Reconstitution in *Haliclystus auricula* Clark. C. M. CHILD. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 2 (1933), 75–106, 29 text-figs.] — The experiment was carried out on the sessile medusoid scyphozoan at the Marine Biological Laboratory of Asamushi, Japan, where the author spent the summer of 1931. Experimental sections were made at different levels and in different directions of the body, and the reconstitution was observed. The results are illustrated by numerous figures and are also summarised in tables. A lengthy discussion of the problem is also given. Shichiroku Nomura.

20. A Study of the Respiratory Conditions in Sea-Water Aquarium. Seiji KOKUBO. [Sci. Rep., Tôhoku Imp. Univ., Ser. VI (Biol.), 8, No. 2 (1933), 111–125.] — The conditions of the sea-water in the exhibition aquarium for the public at the Marine Biological Station of Asamushi were studied with special reference to the oxygen content and pH value. Seasonal variations of the temperature and specific gravity of the outside sea-water and the aquarium sea-water were studied. The paper may be helpful to keepers of aquaria. Shichiroku Nomura.

21. The *Caudina* of Asamushi, the So-called *Caudina chilensis* (Johs. Müller). S. G. HEDING. (Zoological Museum, Copenhagen). [Sci. Rep., Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 2 (1933), 127–142, 4 pls., 2 text-figs.] — Opinions have been divergent as regards the determination of the Japanese species of Molpadid, which is abundant and easily obtainable near the Marine Biological Station of Asamushi, and much used for studies in anatomy, physiology and other branches of biology. The present author supports Dr. Mortensen, who showed in 1925 that the species *chilensis* Johs. Müller, *coriacea* Hutton, and *australis* Semper are well limited species, and also pointed out that the Japanese form *ransonetii* v. Marenzeller could not be the same species as *chilensis* as maintained by H. L. Clark According to the present author, the Japanese species in question is *Paracaudina ransonetii* (Johs. Müller), which forms the genus *Paracaudina*, together with the species *australis, coriacea* and *chilensis*. Shichiroku Nomura.

22. The Colony of the Limpet (*Acmaea dorsuosa* Gould). Noboru ABE. [Sci. Rep. Tôhoku Imp. Univ, Ser. IV (Biol.), 8, No. 3 (1933), 169–187, 9 text-figs.] — The habit of colony formation in the limpet was studied under natural and laboratory conditions. Shichiroku Nomura.

23. On the Presence of the Immovable Cortical Cytoplasm in the Centrifuged Sea-Urchin Egg and its Importance on the Determination of the Polarity. (Preliminary Report.) Isao MOTOMURA. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No. 3 (1933), 255–258.] — The author maintains that the cortical cytoplasm is the only substance that makes the structure on which the polarity of the egg depends. The discrepancies of the results obtained by Runnström, Lindahl and the present author are attributed to the difference in the centrifuging force employed by them in their experiments. Shichiroku Nomura.

24. Studies on Acid of the Body Fluid from an Ascidian, *Chelyosoma siboja* Oka. Satarô KOBAYASHI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 8, No 3 (1933), 277–285. 1 fig., 5 tab.] — Large specimens of the animal supply 40–50 cc of brown-coloured body fluid which contains green pigmented cells with spherical granules, 10 micra in diameter, and large non-pigmented cells, 50 micra in diameter. The volume of the corpuscles in the body fluid is about 40%; the freezing point of the plasma is −2.02°C, that of corpuscles is −2.05°C, and that of the sea-water of the habitat is −1.98°C The pH of plasma is 1.80; that of corpuscles 0.39. The total acidity of the former is 0.027 N, and that of the latter 0.88 N. The SO_4 content is 4.94 g per 1000 cc for plasma and 50.79 g per 1000 cc for corpuscles. Cl, on the contrary, is rich in plasma and poor in corpuscles, amounting to 17.99 g and 2.14 g per 1000 cc of plasma and corpuscles respectively. Phosphorus does not differ much in plasma and corpuscles, amounting

to 4.2 mg and 3.9 mg per 1000 cc respectively.   Shichiroku Nomura.

25. Studies on the Dwarf Disease of Rice Plant. Teikichi FUKUSHI. [Journ. Facul. Agr., Hokkaido Imp. Univ., **37**, Pt. 2 (1934), 41–164, 6 pls.] — The leafhopper, *Nephotettix apicalis* Motsch. var. *cincticeps* Uhl. is the sole means of transmission of the disease, acting as the vector. However, all individuals of this leafhopper are not capable of acting as carriers of the virus. Certain individuals fail to transmit the disease even when they have been hatched and reared on disease plant. A majority of the offspring from infective females, which have been reared on disease plants are capable of producing infections in healthy rice plants. Most of the infective leafhoppers retained their infective power as long as they lived. The progeny from infective female leafhoppers are either viruliferous or free from the virus while those from the crosses between uninfective females and infective males are entirely non-viruliferous. It appears that the eggs are not affected by the virus after they have been deposited but they are probably attacked at an earlier stage of development in the ovaries of the maternal insect. It is evident, therefore, that the leafhopper does not mechanically transfer the virus from disease to healthy plants but that some development or multiplication of the virus takes place within the body of the leafhopper.   S. Kuwayama.

26. Studies on *Lema oryzae* Kuwayama, the Rice Leaf-Beetle. IV Observations on the Biology and Liberation of an Egg-Parasite, *Anaphes nipponicus* Kuwayama. (Japanese with English résumé.) Satoru KUWAYAMA. [Report Hokkaido Agr. Exp. Sta., No. **33** (1935), 1–80+4, 4 pls.] — *Anaphes nipponicus* is only one species known at present parasitic on the egg of the rice leaf-beetle and plays an important rôle in control of the beetle. The author described all stages of this Mymarid-fly. In Hokkaido it seems to pass through 5 or 6 generations per annum; the adults appear early in June and may always be seen until the middle of August. The percentage of parasitism is usually low during the first half of June and increases gradually until the maximum is reached in late July and early August. The period from oviposition to emergence may last from 8 to 13 days; it took 11 and 9 days at daily mean temperatures of 20.3°C and 20.7°C respectively. The emergence takes place in the host egg and the newly emerged adult still remains in it for one day. The time of escaping of the adults from the host egg is limited to early morning. The adults lived about 5 days in mid-July and 1 to 2.5 in early August when confined in a glass vial and fed with diluted honey. Among 1608 adults reared in 1934, 70 per cent of them were females. The number of eggs per individuals in 33 females varied from 4 to 51 and 26.3 on an average. This fly attacks only the egg of the rice leaf-beetle, preferring the host eggs deposited 1 to 3 days previously; it is of positive phototaxis in habit. The egg stage of the parasite lasts less than 24 hours; the larva has 3 instars much different in shape. Two parasites are frequently found in one host egg, and in one case 7 larvae of them were observed. Experiments on the introduction of this parasite to unaffected localities were attempted during 1931–'34. The transplantation at Ikeda, Province of Tokati, gave unsuccessful result, but at Enbetu, Prov. of Tesio, it became readily established though hibernation and reproduction were adversely affected by various conditions. The experiments on the acceleration of the precious efficacy by an additional liberation of this parasite showed that the parasite infestation was more intensive near the apparatus in which many affected egg-masses of the beetle were placed. For instance, at Nagayama, Prov. of Isikari, during June to July the number of adults of the egg-parasite found for every 100 eggs of the beetle varied from 1.40 to 25.64 near the apparatus and 1.22 to 11.64 at some distance from it.
                                             S. Kuwayama.

27. Studies on the Pea Weevil in Hokkaido. I. Spraying Experiments during the Young Pod Stage of Pea-Plant. (Japanese with English résumé.) Satoru KUWAYAMA and Kazue ENDO. [Report Hokkaido Agr. Exp. Sta., No. **34** (1935), 43–59+1] ·· Since its introduction to Hokkaido in 1912, pea weevil (*Bruchus pisorum*) has been widely distributed throughout south-western districts of the island. General survey on the ecology of the weevil is described previous to the record on the results of spraying experiments. In Hokkaido the weevil has but one generation a year, passing the winter mostly in adult stage and occasionally in larval or pupal stages. A pea grain only is admissible to the development of one individual

of the weevil. At present the host plants in Hokkaido are limited to *Pisum sativum* and *P. arvense*.　　　　　　　　　　　　　　　　　　　　　　　　　　S. Kuwayama.

28. Insect-Pests of Poplars and their Relation to Agriculture and Horticulture.
(Japanese.) Hiromichi KÔNO and Kiyoshi SAKURAI. [Journ. Sapporo Soc. Agr. and Forest., **26**, No. 124 (1935), 564–566.] — General remarks on the ecology of 75 species referable to 24 families under 4 orders. Of them 28 species are newly added to the insect fauna of the genus *Populus*.　　　　　　　　　　　　　　　　　　　　　　　　　　S. Kuwayama.

29. Ecological Control of the Strawberry Sawfly. (Japanese.) Toichi UCHIDA and Tsunehisa SHIMIZU. [Journ. Sapporo Soc. Agr. and Forest., **26**, No. 124 (1935), 566–568.] — *Emphytus albicinctus* Matsumura is one of the most serious pests of the strawberry in Hokkaido. It has two generations a year and overwinters in the prepupal stage. The adults emerge in the late May and August According to the author's observation the full grown larvae habitually enter into the crevices of decaying woods or the hollow of straw scattered on the field. So that, as one of the controlling measures, it is recommendable to litter straws on the field and to burn them immediately after the entrance of the larvae.　　　　　　　S. Kuwayama.

30. Macrolepidoptera at Light Traps. (Japanese with English résumé.) Koichi TAMA-NUKI and Haruo YAKU. [Report Saghalien Centr. Exp. Sta., Ser. 2., No. 7 (1935), 1–177+12, 1 pl.] - Results of the light traps for moths conducted during May to October in 1933 and 1934 inclusive. The total number of the species of moths is 279, of which 44 are unrecorded from Saghalien and 25 are newly added to the insect-fauna of Japan. Mean nocturnal temperature has much influence upon the attraction of the moth to light, while maximum diurnal temperature fairly so. Maximum attraction occurs usually towards the middle of night, between 10 p m. and 11 p. m. The moonlight generally hinders the attraction of the moth to light, but even in that case, high temperature acts favorably for the attraction of the moth.　　　　S. Kuwayama.

31. Über einige Bockkäfer Japans. Masaki MATSUSHITA und Koichi TAMANUKI. [Ins. Mats., **10**, No 1/2 (1935), 1–5, 2 figs.] — Beschreibungen von 3 neue Arten, 2 neue Aberrationen und 6 aus dem japanischen Kaiserreich noch nicht beschriebene Arten. Neue Arten: *Nivellia maculata, Strangalia (Strangalina) takeuchii*, und *Demonax jezoensis*. Neue Aberrationen: *Strangalia (Strangalina) dulcis* ab. *atricollis* und *S. dulcis* ab. *sanguinea*.　　　　S. Kuwayama.

32. Zur Ichneumonidenfauna von Tosa. (I). Subfam. Ichneumoninae. Toichi UCHIDA. [Ins. Mats., **10**, No. 1/2 (1935), 6–33.] — Beschreibungen von 61 Arten und 12 Formen; darunter eine Untergattung, 12 Arten und 6 Formen für die Wissenschaft neu sind. Neue Untergattung: *Metopichneumon* [Typus-*Protichneumon superomediae* Uchida]. Neue Arten: *Protichneumon (Metopichneumon) superomediae, Coelichneumon kodakasaensis, C. sugiharai, Melanichneumon wadai, Barichneumon hirookaensis, Cratichneumon hongawaensis, C. kochiensis, C. okamotoi, Ichneumon sugiharai, Ctenichneumon kamegamoriensis, Hepiopelmus craspedon*, und *Platylabus wadai*. Neue Formen: *Facydes purpureomaculatus* f. *nigroguttatus, Amblyjoppa japonica* f. *tosaensis, Coelichneumon cyaniventris* f. *shikokuensis, Melanichneumon leucomelas* f. *tosaensis, Cratichneumon nigritarius* f. *shirowanus*, und *C. femoratus* f. *teranishii*. Sonstige neue Form: *Callajoppa lutoria* f. *septentrionalis* (von Sachalin und Hokkaido).　　　　S. Kuwayama.

33. Über die Gattung *Musidora* Meigen (Musidoridae). (Neue und wenig bekannte Dipteren aus Japan. III.) Ichiji OKADA. [Ins. Mats., **10**, No. 1/2 (1935). 34–41, 3 figs.] — Beschreibungen von 5 Arten; darunter 2 Arten, *M. apicalis* und *M. platytarsis*, für die Wissenschaft neu sind, und eine Art, *M. stackelbergi* Czerny, für Japan neu ist.　　　　S. Kuwayama.

34. A New Species of Butterfly from Formosa. Shonen MATSUMURA. [Ins. Mats., **10**, No. 1/2 (1935), 42, 1 fig.] — Description of a new Nymphalid-species, *Pantoporia hirayamai*.　　　　　　　　　　　　　　　　　　　　　　　　　　S. Kuwayama.

35. On Some Species of Braconidae from North China and Korea. Chihisa

WATANABE. [Ins. Mats., **10**, No. 1/2 (1935), 43–51, 1 fig.] — Of 13 enumerated species, 5 are described as new to science, i, e., *Habrobracon pectinophorae, Apanteles taoi, A. eguchii, A. dero-gatae,* and *A. parnarae.*   S. Kuwayama.

36. Die Curculioniden aus den Kurilen. II. (Fünfter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., **10**, No. 1/2 (1934), 52–63.] — Notizen über 40 Arten, von denen 6 für die wissenschaftliche Welt und 13 für die Kurilen neu sind; insbesondere tiergeographisch sehr bemerkenswert ist das Vorkommen der 2 europäischen Gattung *Anoplus* und *Orobitis.* Neue Arten: *Xenomimetes todomatsuanus, Dorytomus (Praeolamus) etorofuensis, D. shikotanus, Rhinoncus uchidai, Orobitis apicalis* und *Anoplus sugiharai*
                                                      S. Kuwayama.

37. One New Dragonfly from Hokkaido. Teiichi OKUMURA. [Ins. Mats., **10**, No. 1/2 (1935), 1 pl., 64–66] - Description of *Gomphus moiwanus* Matsumura et Okumura, n. sp.
                                                      S. Kuwayama.

38. A New Braconid-Parasite of the Bark-boring Beetle, *Cryphalus piceus* Eggers. Hiromichi KÔNO and Chihisa WATANABE. [Ins. Mats., **10**, No. 1/2 (1935), 67–70, 1 fig.] — Description of *Ecphylus hattorii.*   S. Kuwayama.

39. Supplementary Note to the Revision of *Stenocranus* and Allied Species of Japan Empire. Shonen MATSUMURA. [Ins. Mats., **10**, No. 1/2 (1935), 71–78] - Descriptions of 4 new genera and 12 new species. New species: *Stenocranus sukumonus, S. takasagonis, Unkana formosella, U. kushiana, U. sakaguchii, U. sapporona, U. taiwanella, Hosunka pallidula, Kakuna kuwayamai, Epunka bilineata, Toya sapporonis,* and *Toyoides albipennis.* New genera: *Hosunka* (Typus-*H. pallidula*), *Kakuna* (Typus *K. kuwayamai*), *Epunka* (Typus-*E. bilineata*), and *Toyoides* (Typus-*T. albipennis.*)   S. Kuwayama.

40. A New Genus and a New Species of Derbidae from Fukushima. Shonen MATSUMURA [Ins. Mats., **10**, No. 1/2 (1935), 79–80, 1 fig.] — Description of *Nomuraida hibarensis* gen. et sp. nov.   S. Kuwayama.

41. Beitrag zur Cerambyciden-Fauna von Mikronesien. Masaki MATSUSHITA. [Trans. Sapporo Nat. Hist. Soc., **14**, Pt. 2 (1935), 115–122, 1 fig.] - Beschreibungen von 12 Arten. Neue Arten: *Rhaphipodus carolinensis, Ceresium yoshinoi, C. nanyoanum, Nanyohammus luteo-sparsus, Niphohammus auripilis, Pterolophia palauana, Prosoplus uchiyamai, P. lividus,* und *Sybra carolina.* New genus: *Nanyohammus* (Typus-*N. luteosparsus*).   S. Kuwayama.

42. Die Mordelliden Japans. Fünfter Nachtrag. Hiromichi KÔNO. [Trans Sapporo Nat. Hist. Soc., **14**, Pt. 2 (1935), 123–130, 3 fig.] - Notizen über 20 Arten. Neue Arten: *Higehananomia palpalis, Hoshihananomia pirika, Mordellistena okamotoi,* und *M. shizuokana.* Neue Gattungen: *Higehananomia* (Typus-*H. palpalis* Kôno), *Yakuhananomia* (Typus *Tomoxia yakui* Kôno), und *Hoshihananomia* (Typus-*H. pirika* Kôno).   S. Kuwayama.

43. On *Dioryctria (Phycis) abietella* Schiff. (Japanese.) Motonori INOUE. [Journ. Hokkaido Forest Soc., **33**, No. 396, 631–633, 1 fig.] — The Pyralid, *Dioryctria abietella,* is one of the serious sylvan pests in Hokkaido, injurious to *Picea* spp. and occasionally to *Abies* spp. Near Sapporo, there is only one brood a year, and hibernation takes place in the larval stage. Adults emerge in June and July, and the female oviposits upon the cones or twigs of food tree. The larvae attack the cones and twigs during summer and mature in October, then enter into the soil to make white cocoons, in which they hibernate.   S. Kuwayama.

44. Apparent Crossing-over in the Female of *Bombyx mori*. (Japanese.) Yoshimaro TANAKA and Y. CHIANG. [Jap. Journ. Genetics, **12**, No. 1 (1936), 17–20.] — Because no crossing-over occurs in the female of the silkworm, in the backcross (PY × py) $F_1 ♀ × py ♂$, only the two phenotypes PY and py are expected in 1:1 ratio. Among the offspring of X-rayed $F_1 ♀$ of

the above cross backcrossed with py♀, one pȲ appeared. This is however due to the mutation of P into p induced by irradiation instead of being a crossing-over. T. Komai.

45. A Preliminary Note on the Distribution Types of the Tracheae in the Silkworm. (Japanese.) Shigetaro MORI. [Jap. Journ. Genetics, 12, No. 1 (1936). 21-23.]—The mode of distribution of tracheae in the 3rd thoracic and 1st abdominal segments is a heritable character. Each race has a characteristic type. T. Komai.

46. On the Genetical Studies in Carp (A Preliminary Note). (Japanese.) Yoshiichi MATSUI. [Jap. Journ. Genetics, 12, No. 1 (1936), 44-47.]—A preliminary account on the results of breeding experiments since 1922 including ca. 150,000 individuals. Of the new mutant types which have appeared during the experiments, *albino* and *red-eyed yellow* showed variable results in the cross with other types, and suggest their complicated genic complexes. Also, two new mutations in the character of scale, *large scale* and *transparent scale*, were found. T. Komai.

47. The Chromosomes of *Panulirus japonicus* (de Haan) (A Preliminary Note). (Japanese.) Hidejiro NIIYAMA. [Jap. Journ. Genetics, 12, No. 1 (1936), 53-54.]—The spermatogonial group consists of 140 chromosomes of which 12 are V's, while all others are rods and dots. The 12 V's may be subdivided into 2 classes according to size, each comprising 6 chromosomes. Both the first and second spermatocytes contain 70 chromosomes. In the first cyte are recognized 3 compound ring tetrads which are apparently resulted from pairing of the larger V's. No chromosome which showed a sex-chromosome-like behavior was found. T. Komai.

48. The Cytoplasmic Influence on the Egg-colour in the Silk Worm (A Preliminary Note). (Japanese.) Kanichiro SUZUKI [Jap Journ. Genetics. 12, No. 1 (1936), 55-58]—The breeding experiments since 1931 has confirmed that the genic formula of the bivoltine white-egg race 'Hakuryû' and bivoltine slaty-egg Chinese race may be designated respectively as aaBB and AABB; these A and B behave as supplementary factors in producing the slaty color. B functions in the ordinary manner, A, on the other hand, functions in the manner characteristic to the 'maternal' inheritance. The egg-colour is dependent entirely on the character of plasm irrespective of the zygotic composition. T. Komai.

49. Sexual Difference of Chromosomes in the Soft-shelled Turtle (A Preliminary Note). (Japanese.) Kan OGUMA. [Jap. Journ. Genetics, 12, No. 1 (1936), 59-61.]—The spermatogonial complex consists of 64 (32 pairs) chromosomes which may be classified into 12 (6 pairs) large and 52 (26 pairs) small chromosomes. The oogonial complex consists of 63 chromosomes (31 pairs + 1). The unpaired chromosome which belongs to the smaller group is apparently the sex-chromosome. T. Komai.

50. A Case of Inversion in the Fifth Chromosome of *Drosophila virilis* (A Preliminary Note). (Japanese.) Mitsushige CHINO. [Jap. Journ. Genetics. 12, No. 1, 63-64 (1936).]—A case of inversion including the whole left half of the 5th chromosome was found in a wild strain. The inversion reduces the crossing-over value mainly of the left half considerably, but not entirely. The results of breeding were confirmed by the observation on the salivary chromosomes. T. Komai.

51. Chromosomes of *Drosophila ananassae* (A Preliminary Note). (Japanese.) Hideo KIKKAWA. [Jap. Journ. Genetics, 12, No. 1 (1936), 65-66.]—The oogonial chromosome complex consists of 4 pairs of V's of which one pair are slightly shorter than the rest. In the spermatogonial complex one of the larger V's is replaced by a rod (more precisely a J). This shows that the rod is Y, and one of the larger V's is X. The linkage groups are only 3, suggesting that one of the 4 pairs are inert. This has been confirmed by the examination of the salivary chromosomes. The inert chromosomes are the shorter V's. T. Komai.

52. On Another Form of *Stephanoscyphus* found in the Waters of Japan. Taku KOMAI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 11, No. 3 (1936), 175–183.] — Some specimens apparently belonging to *Stephanoscyphus* and probably specifically different from the form common in the vicinity of Seto have been discovered in rather deep regions of the Japan Sea and Sagami Bay. These are isolated thecae without a coating of sponge. They are provided with sets of conical projections on the inner wall at rather regular intervals, exactly as in the forms previously described by Allman and Schulze from the Mediterranean. These projections are missing in the Seto specimens; moreover the latter undergo racemose branchings, in contrast with the irregular lateral branchings of Schulze's specimen and also the creeping colony of Allman's specimen. Hence the tentative classification of the Genus *Stephanoscyphus* into *S. corniformis* n. sp., *S. mirabilis* Allman, *S. fistularis* (Schulze) and *S. racemosus* n. sp. seems warranted.   Author.

53. The Nervous System in Some Coelenterate Types. 1. *Cœloplana.* Taku KOMAI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 11, No. 3 (1936), 158–191.] — The nervous system of *Cœloplana bocki* Komai has been studied by the aid of vital staining method with rongalit white. The dorsal side contains no nerves except in the marginal zone where nerve cells, probably sensory, are found in abundance. The ventral side shows nervous elements all over. But the marginal region is especially rich in these elements. Of this region the outermost zone contains nerves which are probably sensory, while the next zone has nerves probably motor in nature. In polar plates nerve-cell-like bodies occur in the region between the central and marginal areas. Otherwise there is no element resembling nerves in the sense-organ nor in the parts surrounding it.   Author.

54. Bopyrids from Tanabe Bay. III. Sueo M. SHIINO. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 11, No. 3 (1936), 157–174.] — *Bopyrella angusta* n. sp., *Bopyrinella antilensis* var. *nipponica* n. var., *Onychocepon resupinum* n. sp., *Grapsicepon magnum* n. sp., *G. rotundum* n. sp., *Cataphryxus* n. g. *priminus* (Shiino).   T. Komai.

55. Infection Experiments of *Ascaridia perspicillum* in Mice. (Japanese with English abstract) Chiyosaburo SATO. [Keio Ig. 15, No 3 (1935), 391–395.] — When the ova of *Ascaridia perspicillum* are kept in the tap water at 28°C, the larvae in them reach their maturity in seven days. The infective larvae given orally to mice hatch out in the stomach and the upper part of small intestine and penetrate into the mucous membrane at the lower part of ileum, coecum and rectum. They increase in size, but do not migrate into the other parts of the body and are finally discharged out of the body. The duration of their staying in the intestinal canal is only 5 days.   N. Ishii.

56. Repeated Infection Tests of Hook-worms. (Japanese with English abstract.) Junzo SUZUKI. [Keio Ig. 15, No. 3 (1935), 397–422, 9 figs.] — The infective larvae of *Ancylostoma caninum* given orally to rats were found in the liver and lung after 18 hours, the maximal number being reached after 24 hours and continued to be found there for 5 days. The larvae in the organs were found increased in both their length and size. The larvae of *Ancylostoma duodenale* administrated in just the same way appeared in the organs after 2 days, the maximal number being attained on third day, and continued to be found for 10 days. If *Ancylostoma caninum* was administrated for the second time 5 days after the first, the larvae appeared in the organs as early as 3 hours after the administration. Results of the third and fourth infections, each administrated 5 days after the previous infection, gave the same result as regards the time of the first appearance, but the duration of presence in the organs were remarkably elongated, being found for 10 days after the administration. The number of the larvae, however, were found diminished in proportion to the number of repetition of infection. In the animals infected four times, they were distinctly decreased in number. The larvae of the after infections were found larger than those of the previous infections. Reinfections after 30 days gave almost the same result with that of fourth infection.   N. Ishii.

57. On a Rare Case of Plerocercus Parasitic in a Monkey. (Japanese with English abstract.) Makoto KOIDZUMI and Kikuo YAMADA. [Keio Ig. 15, No. 6 (1935), 941–945, 5

figs.] — The authors found 28 larvae on the omentum and 12 larvae enclosed in cysts on it of a Macacus monkey. A few numbers were also found on the surface of the lung, liver and diaphragm, and 2 small ones in the lung. The cysts containing the larvae assume ovoid shape of various sizes and were found fixed to the surface or hanging from it. Some are of cocoon-shape and their inner cavity is separated into two, one larva being situated in each of them. The average length and breadth of the larvae are 2.7 mm (5.6–1.0 mm) and 1.1 mm (1.8–1.0 mm) respectively. The anterior end is broader than the posterior and invaginated, provided with well developed suckers. The wall of the cysts consists of connective tissue fibres arranged in clear layers, free from any connection with the parasite. The larvae in the cysts are found generally showing signs of degeneration, some of them being completely degenerated.   N. Ishii.

58. Eimeria Parasitic in Marine Fishes. (Japanese with English abstract.) Hisakiti MATUBAYASI. [Keio Ig. 15, No. 9 (1935), 1281–1300, 39 figs.] - The author examined *Trachurus trachurus, Cololabis saira* and *Sardina melanosticta,* and found spherical oöcysts of *Eimeria* in their liver. Specimens from the first and third ones were identified as *E. cruciate* and *E. clupearum* respectively, while the second one seemed to be an undescribed species. These oöcysts are almost equal in average length of diameter, excepting the large sized ones of *E. cruciata.* Experiments proved that the osmotic pressure of the sporocysts of all of the species to be nearly isotonic with sea-water. The author found also many oöcysts in the testis of the sardine, and identified them to be *E. sardinae.* Sporogony was followed in some details, but schizogony and gametogony were unable to follow.   N. Ishii.

59. Periodicity of the Larva of Dirofilaria immitis. (Japanese with English abstract.) Taro INOUE. [Keio Ig. 15, No. 10 (1935), 1423–1432.] — To obtain some good idea regarding the periodicity of the microfilaria of *Dirofilaria immitis* in dogs in Japan, the author carried out the examinations of the blood of dogs infested with the parasite. Four dogs were used and examinations were done every 2 hours for 24 hours. Unfortunately one dog did not live long enough for repeated examinations, but in the 3 others examinations were repeated. The results are shown in tables and figures in the text, showing very remarkable periodicity. The adult worms were carefully searched after death of the animals and numerical ratio of the larvae and the adult worms were estimated in every case.   N. Ishii.

60. Limnological Investigations of Formosan Lakes. (Japanese.) Denzaburo MIYADI. [Jap. Journ. Limnol., 5, No. 3 (1934), 71–86, 12 figs, 8 tabs.] — Limnological observations on four representative lakes in Formosa, viz. Rigyo-ti, Toapi-ike, Zitugetu-tan and Uzanto-tyosuiti, were made in April, 1935. These lakes are characterized by the high temperature (18–20°C) and the thick deoxygenated layer in the bottom stratum. One of the most prominent faunal features of them is their extraordinary poorness both qualitatively and quantitatively.   Author.

61. Abnormal Distribution of Plankton in a small Mountain Pond. (Japanese.) Syuiti MORI and Kanzi MORI. [Jap. Journ. Limnol., 5, No. 3 (1935), 99–105, 1 fig., 4 tabs.] — The unequal horizontal distribution of the plankton in Kozyoro-ike (at an altitude of 1070 m above sea level) on Mt. Hôrai of the Hira mountain range, Siga-ken, was interpreted as to be caused by the unequal nature of the bottom deposits.   D. Miyadi.

62. Insect Fauna of a Mountain Stream. (Japanese.) Isamu HORASAWA and Nobuichi IMAFUKU. [Jap. Journ. Limnol., 5, No. 3 (1935), 107–114, 2 figs, 2 tabs.] — The fauna of the Yazawa stream, a branch of the River Kiso in Sinano Province and extending between the altitudes from 780 to 2000 m, was studied with some ecological conditions such as the water temperture, pH and alkalinity. The region (about 1000–1400 m) with the summer water temperature of 10–14°C seems to be the boundary for the distribution of the cold-water stenothermal and warm-water stenothermal species.   D. Miyadi.

63. The Relation between the Horizontal Distribution of Heleoplankton and the Depth of Water. (Japanese.) Isamu HORASAWA. [Jap. Jour. Limnol., 5, No. 4 (1935), 140–145, 5 figs, 5 tabs.] — The population of plankton organisms (the majority of them belongs to

the phytoplankton) in two small ponds was studied with the result that its density is greater in deeper area of the pond than in shallower region. The author interpreted this phenomenon as being caused by the disturbance of the water, which is greater near the center of the pond and hinders the sinking down of the plankton organisms, instead of attributing it to the 'Uferflucht' as is sometimes observed in the macroplankton of the lakes.   D. Miyadi.

64. On the Bottom Fauna of the Biwako-canal (Sosui) in Autumn. (Japanese.)
Matsunae TSUDA and Hidekichi YAMAGUCHI. [Jap. Journ. Limnol., 6, No. 1, (1936), 11-20, 4 figs, 4 tabs.] — The fauna of the Biwako-canal which connects Lake Biwa with Kyôto was studied quantitatively. In total 15 and 19 species were collected from sand and stone bottoms respectively, of which 11 were common to both. The larvae of *Macronema radiatum* (Trichoptera) and *Corbicula sandai* (Mollusca) were dominating every-where. Thus the edaphic differences between sand and stone bottoms in this canal is unimportant for the distribution of the bottom fauna.   D. Miyadi.

65. Preliminary Survey on the Second Limnological Expedition to Formosa.
(Japanese.) Masuzo UÉNO. [Jap. Journ. Limnol., 6, No. 1 (1936), 33-47, 3 figs, 8 tabs.] — Limnological survey in Formosa was carried out in July 1935 at fifty-six different stations including lakes, ponds, marshes, mountain rapids, streams, rivers, hot and cold springs, etc. The bottom fauna of the lakes is very poor. The plankton of the lakes is composed chiefly of zooplankton. The composition of the plankton fauna in Zitugetu-tan is altered essentially owing to the change of the limnological conditions after the damm construction. The ecological aspects of the fauna of the high mountains are similar to those of the northern regions. As zoogeographically notable species may be cited the following species: a northern relic salmon *Oncorhynchus masou* with a parasitic Nematoda *Cystidicola salvelini* (Fujita) which is often found in some salmonoid fishes in Hokkaido and Honsyu; three species belonging to Blephaloceridae found in the mountain streams; both southern (*Diaphanosoma paucispinosum, Ceriodaphnia rigandi*) and China-Manchurian elements (*Eudiaptomus birulai*) among the plankton of the lowland region; both northern (*Daphnia pulex obtusa*) and south Chinese elements (*Eudiaptomus incongruens*) in some mountain ponds. An Indian element *Psephenoides gahani* (Coleoptera) in the waters east of the central mountain range.   D. Miyadi.

Abstracts

66. Annélides Polychètes du Japon. Pierre FAUVEL. [Mem. Coll. Sci., Kyoto Imper. Univ., Ser. B, **12**, No. 1 (1936), 41 92.] — A report of the polychaete fauna in the vicinity of the Seto Marine Biological Laboratory. 70 species belonging to 55 genera and 22 families are represented, including *Eunice ovalifera* n. sp. From the zoo geographic view point, the polychaete fauna of Japan is noteworthy because of the mixture of septentrional and tropical forms. This is mainly due to the influence of the Kurosiwo and Oyasiwo which bring the warm and cold waters to the coast of Japan. Some remarks are put to each species enumerated.

T. Komai.

67. Larval Development and Metamorphosis of *Argulus japonicus*. Takasi TOKIOKA. [Mem. Coll. Sci., Kyoto Imper. Univ., Ser. B, **12**, No. 1 (1936), 93–114.] — The change in the external forms during the first to last stage is described in detail. T. Komai.'

68. The Chromosomes of some Neuropterous Insects. (Japanese.) Hisao KICHIJÔ. [Jap. Jour. Genetics, **12**, No. 2 (1936), 97.] — The spermatogonial complexes of 6 Indian species have been examined. *Glyptobasis dentifera* and *Ogogaster segmentator* 2n=22; *Myrmecoelurus acerbus* n=7; *Macronemurus* sp. and *Neuroleon* sp. 2n=16, n=8; *Myrmeleon sogax*? n=7. The sex chromosomes are of the xy type in all the species examined. T. Komai.

69. Two races of *Drosophila montium*. (A preliminary note.) Hideo KIKKAWA. [Jap Jour. Genetics, **12**, No. 3 (1936), 137–142.] — The two races, A and B, of *Drosophila montium* may be distinguished by a slight difference in the number of teeth of the combs on the tarsal segments of the foreleg of the male. More pronounced difference may be found in the chromosome complex. In race A the oogonial complex comprises 2 large V, 1 small V and 1 rod pairs; in the spermatogonial complex one of the rods is replaced by a small V. In the oogonial complex of race B the small V's in race A are replaced by a pair of rods. The Y is a small V in both A and B, and the X should be a rod in both of the races. In the salivary chromosome sets there are 6 chromosomes of which one is much shorter than the rest and ring-shped in both races. This shows that the ring chromosome is the sex-chromosome, and also that this chromosome is formed by inert substance except a small portion at the base.

T. Komai.

70. Salivary Gland Chromosomes of *Drosophila virilis*. (Japanese.) Sukeichi FUJII. [Jap. Jour. Genetics, **12**, No. 4 (1936), 171–176, 1 pl.] — The relation between the salivary gland chromosomes and the linkage groups of *Drosophila virilis* has been worked out, and a chart involving the complete set of the salivary gland chromosomes is presented. The detailed statement on this problem has been published in 'Cytologia', Vol. **7**, pp. 272–275. T. Komai.

71. Crossing-over in the Female of *Bombyx mori*, with Statements on some X-ray Mu'ations. (Japanese.) Hisao ARUGA. [Jap. Jour. Genetics, **12**, No. 4 (1936), 178–182.] — Female pupae heterogeneous for two dominant genes S and Y in the II chromosome were X-r. yed and crossed to *py* males. 11 crossovers appeared in the treated series out of 6630 worms. Also several mutants of *Striped* were found. T. Komai.

72. The Behaviour of *Plexate*, a Mutant Gene of *Drosophila ananassae*. Daigorô MORIWAKI. [Jap. Jour. Genetics, **12**, No. 4 (1936), 183–188.] — *Plexate* flies of *Drosophila ananassae* are some.imes accompanied by a *balloon*-like character This character is heritable, and may be enhanced by selection. *Plexate* is produced by a gene located in the second chromosome, and is intensified by the third chromosome factor *balloon*. The expression of *Plexate* character is highly variable. Females are more apt to show the character than males. T. Komai.

73. The Genetics of *Drosophila virilis*. (Japanese.) Mitsushige CHINO. [Jap. Jour.

Genetics, **12**, No. 4 (1936), 189-210, No. 5 (1936), 257-277, 5 pls., to be continued). Detailed state-
ments of the author's findings on the genetics of the species. The first part contains the Introduc-
tion, Distinctive Characters and Distribution of the Species and the Chromosome Map. The second
part includes the Descriptions of Mutants with a number of illustrations.   T. Komai.

74. Six New Species of Homoptera collected at Okinawa by Mr. Chiro Yohena.
Shonen MATSUMURA. [Ins. Mats., **10**, No. 3 (1936), 81-84.] — Descriptions of *Centrotus* (*Gar-
gara*) *okinawanus* n. sp. (Membracidae), *Gergithus okinawanus* n. sp., *Sarima yohenai* n. sp.
(Issidae), *Aphrophora okinawana* n. sp. (Cercopidae), *Cixius yohenai* n. sp., and *C. okinawanus* n.
sp. (Cixiidae), and notes on *Betacixius kumejimae* Mats.   S. Kuwayama.

75. Eine neue Art von Scoliidae aus Kiushu. Toichi UCHIDA. [Ins. Mats., **10**, No.
3 (1936), 85-86, 1 fig.] — Beschreibung von *Scolia* (*Scolia*) *yasumatsui* sp. nov.
                                                                  S. Kuwayama.

76. A New Genus of Papilionidae. Shonen MATSUMURA. [Ins. Mats., **10**, No. 3
(1936), 86, 1 pl.] — Erection of the genus *Agehana* based on *Papilio maraho* Shiraki et Sonan.
                                                                  S. Kuwayama.

77. Neue und wenig bekannte Käfer Japans. I. Hiromichi KÔNO. [Ins. Mats.,
10, No. 3 (1936), 87-98] — Notizen über 26 Arten unter 4 Familien, von denen 11 für die wis-
senschaftliche Welt neu sind. Neue Arten: (Rhipiphoridae) *Pelecotoma septentrionalis, Macros agon
iwatai;* (Meloidae) *Epicauta taipina, Meloë* (*Proscarabaeus*) *sapporensis, M.* (*P.*) *menoko, Zonitis
okinawensis* (Miwa, MS.), *Z. miwai, Z. kimi, Horia tosana, Cissites* (*Synhoria*) *sasakii;* (Pyroch oidae)
Dendroides nakabusana.   S. Kuwayama.

78. Einige Nematoceren aus den Süd-Kurilen (Diptera). Ichiji OKADA. [Ins. Mats.,
10, No. 3 (1936), 99-103, 1 fig.] — Beschreibungen von 3 Fungivorid-, 2 Phryneid-Arten und 1
Bibionid-Art.   S. Kuwayama.

79. Die Heteromeren aus den Kurilen. II. (Sechster Beitrag zur Kenntnis der Käfer-
fauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., **10**, No. 3 (1936), 104-106.] — Notizen über
13 Arten unten 6 Familien.   S. Kuwayama.

80. Materials for the Study of the Neuropteroid Fauna of the Kurile Islands. I.
Satoru KUWAYAMA. [Ins. Mats., **10**, No. 3 (1936), 107-110.] — Enumeration of 10 species of
Neuroptera and one species of Mecoptera.   S. Kuwayama.

**81. Drei neue Gattungen sowie acht neue und fünf unbeschriebene Arten der
Ichneumoniden aus Japan.** Toichi UCHIDA. [Ins. Mats., **10**, No. 3 (1936), 111-122, 6 figs.]
— Neue Gattungen: *Badyorygma* [Typus: *B. flavoguttatum* Uchida], *Cochlidionostenus* [Typus:
Cryptaulax coreanus Szépligeti], und *Myrmeleonostenus* [Typus: *M. babai* Uchida]. Neue Arten:
*Badyorygma flavoguttatum, Amblytelus fennicae, Myrmeleonostenus babai, Microcryptus setiferae,
Omorgus alsophilae, Polysphincta* (*Zaglyptus*) *iwatai, Perilissus* (*Spanotecnus*) *athaliae.* Neue
Form: *Eriogorgus fibulator* Gravenhorst f. *coreanus.*   S. Kuwayama.

82. A New Species of Sapygidae from Korea (Hym). Yuzo SUGIHARA and H. K.
KIM. [Ins. Mats., **10**, No. 3 (1936), 123-126, 2 figs.] — The new species is described under the
name *Polochrum koreanum.*   S. Kuwayama.

83. Two New Butterflies from Formosa. Shonen MATSUMURA. [Ins. Mats., **10**,
No. 4 (1936), 127-128, 2 figs.] — *Hestina assimilis hirayamai* n. f. and *Huphina nadina hirayamai*
n. f.   S. Kuwayama.

84. Two New Species of Aphididae from Hokkaido. Motonori INOUYE. [Ins. Mats.,
10, No. 4 (1936), 128-134, 2 figs.] — Descriptions of *Cinara ezoana* n. sp., parasitic on *Picea Glehni*
and *P. jezoensis*, and *Tuberolachnus todocolus*, parasitic on *Abies mayriana* and *A. sachalinensis.*
                                                                  S. Kuwayama.

85. Erster Nachtrag zur Ichneumonidenfauna der Kurilen (Subfam. Ichneumoninae). Toichi UCHIDA. [Ins. Mats., 10, No. 3 (1936), 135-146, 2 figs.] — Beschreibungen von 29 Arten; darunter 7 Arten für die Wissenschaft neu sind. Neue Arten: *Cratichneumon longicaudatus, C. chishimanus, Hypomecus tylus, Ectopius marginalis, Phaeogenes shiodai, Ischnus shikotanensis,* und *Diadromus shakotanus.*   S. Kuwayama.

86. Eine neue *Lepyrus*-Art aus Japan. F. ZUMPT. [Ins. Mats., 10, No. 4 (1936), 146-147, 1 fig.] — Beschreibung von *Lepyrus flavipunctatus* n. sp.   S. Kuwayama.

87. Die Clavicornien aus Kurilen. (Siebenter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 10, No. 4 (1936), 148-153] — Notizen über 17 Arten unter 6 Familien, von denen eine Art, *Languriomorpha kunashiriana,* für die Wissenschaft neu ist.   S. Kuwayama.

88. Fauna of the Thysanoptera in Japan. Part VI. Masato ISHIDA. [Ins. Mats., 10, No. 4 (1936), 154-159, 2 figs.] — Detailed descriptions of *Ecacanthothrips piceae* and the larvae of *Elaphrothrips* sp.   S. Kuwayama.

89. Materials for the Study of the Neuropteroid Fauna of the Kurile Islands. II. Satoru KUWAYAMA. [Ins. Mats., 10, No. 4 (1936), 160-163, 1 fig.] — Enumeration of 8 species of Trichoptera.   Author.

90. Apple Tree Insects of Hokkaido. (Japanese.) Satoru KUWAYAMA. [Lectures on Horticulture (" Engei Kôshûkwai Kôen Yôroku "), No. 4 (1936), published by the Hokkaido Government, 87–118] — More than 135 species are known to affect in greater or less degree the apple tree or its fruits in Hokkaido, 53 of them being considered as princial pests. They are classified into 5 insect orders, i. e., Lepidoptera 81 spp. (60.0%), Coleoptera 30 spp. (22.2%), Hemiptera 22 spp. (16.3%), both Hymenoptera and Odonata 1 sp. (0.7%). The insects harmful only during larval stage predominate, being 86 spp. (63.7%), other ones that harmful during both larval and adult stages and only adult stage, being 27 spp. (20.0%) and 22 spp. (16.3%). If classify them in accordance with the character of the injury they may be divided into 5 groups: injuring the foliage 99 spp. (73.3%), injuring trunk or branch 23 spp. (17.0%), injuring fruit 10 spp. (7.4%), injuring blossom 2 spp. (1.5%) and injuring root 1 sp. (0.8%). The biting and sucking insects are 110 spp. (81.5%) and 23 spp. (17.0%) respectively, besides 2 spp. (1.5%) of mechanical injury by oviposition.   Author.

91. On the Scales of Ayu, *Plecoglossus altivelis* Temminck & Schlegel. (Japanese.) Hisawo KOBAYASHI. [Jap. Jour. Limnol., 6, No. 2 (1936), 56–62, 5 figs] — The scales of *Ayu* begin to develop soon after the fish reached 5 cm in length and still in the sea, and the formation of the pigment cells takes place simultaneously. The scales are simple in structure, having inconspicuous circuli but no radii, and in these respects they are similar with those of the fishes of Salmonidae under which family *Ayu* was formerly placed. The writer considers the scale to be a reliable characteristic for judging the systematical position of fishes and shares the opinion with Y. T. Chu that the scales on the sides of the caudal peduncle are the most fitted for this purpose.   D. Miyadi.

92. Plankton of Strongly Acid-Water Lake Osoreyama-ko. (Japanese.) Tadashi TAMURA. [Jap. Jour. Limnol., 6, No. 2 (1936), 63–73, 1 fig., 2 tabs.] — The pH value of Lake Osoreyama-ko (altitude 205 m; area 2.17 sq. km; depth 15 m.) near the north end of Honsyû varied between 3.0–3.6 during 1931–34, and the inflow of hot-spring water containing sulphuric acid is responsible for this acidity. The lake is inhabited by many macroscopic animals such as the insect larvae and a Cyprinoid fish *Leuciscus hakonensis* Günther, and the Phanerogamic vegetation flourishes in the shore region. The constituent species of the zooplankton are very few (Copepoda 1 sp., Cladocera 3 spp., Rotatoria 4 spp., aquatic insects 2 spp.). *Simocephalus vetulus* is by the most numerous and *Brachionus urceolaris* comes to the next. The phytoplankton is very poor both in the number of species and the quantity. The plankton attains its maximum

development in the summer season. In August most of the zooplanktons occur in the deeper strata in the day time and near the surface at night. D. Miyadi.

93. Inland Waters near Siwobara. (Japanese.) Masajirô YAMADA. [Jap. Jour. Limnol., **6**, No. 3 (1936`, 116–128), 3 figs.] — The influences of hot-springs in Siwobara district (north of Tôkyô) on the water of the Hôki-gawa river system were studied. While only two and four species of Trichoptera and Simuliidae were discovered at stations with pH values of 4.7 and 5.1 respectively, not less than 12 species of insect larvae and some fishes were collected at a station with the pH value of 7.2. D. Miyadi.

94. Pyramidellidae from Siogama Bay, Northeast Honsyû, Japan. S. NOMURA. [Saitô Hô-on Kw. Mus. Res. Bull., No. **10** (1936), 1–108, 12 pls.] — 95 species belonging to 11 genera, 14 subgenera and 17 sections are listed. One subgenus and two sections are newly proposed; of the 95 species 79 are new to science. This report is the first of its kind, and facilitates not only the biologists but also others who are working in the field of natural science. S. Ohfuchi.

95. Remarks on the Loop of Certain Brachiopoda. K. HATAI. [Saitô Hô-on Kw. Mus. Res. Bull., No. **10** (1936), 219–229, 41 text-figs.] — The development of the loop of various brachiopod genera are dealt with and the possible route of migration in former times is outlined. S. Ohfuchi.

96. On the Geographical Distribution of Certain Marine Shell-Bearing Molluscs and Their Geologic Significance. S. NOMURA and K. HATAI. [Saitô Hô-on Kw. Mus. Res. Bull., No. **10** (1936, 195–208.] — The species common to Northeast Japan and Northwest America are listed and their geological range is studied from the point of migration. S. Ohfuchi.

97. A Short Note on the Shells of Certain Invertebrates. S. NOMURA and K. HATAI. [Saitô Hô-on Kw. Mus. Res. Bull., No. **10** (1936), 212–217.] — The relationships of the shell of certain marine invertebrates to depth, latitude and ecological conditions are discussed. S. Ohfuchi.

98. Protozoan Fauna in the Vicinity of Sendai. (Japanese.) Hayao SATÔ. [Saitô Hô-on Kw. Hak. Zihô., No. **28** (1935), 7–12.] — 10 species of Rhizopoda, 17 species and 2 unknown species of Mastigophora, 6 species and 1 unknown species of Sporozoa are listed from the vicinity of Sendai. S. Ohfuchi.

99. A List of Chitons in the Collection of the Saitô Hô-on Kwai Museum. (Japanese.) Isao TAKI. [Saitô Hô-on Kw. Hak. Zihô., No. **30** (1936), 1-2.] — 12 species and some new species of Chiton belonging to 7 genera and 4 families are listed. S. Ohfuchi.

100. Distribution of the Spiders in Iwate Prefecture. (Japanese.) O. SHINJI and O. ONO. [Saitô Hô-on Kw. Hak. Zihô., No. **30** (1936), 6–16] — 213 species belonging to 84 genera, 25 families, 4 superfamilies and 1 subfamily and 2 suborders are listed. S. Ohfuchi.

101. A Preliminary List of the Ants of Morioka, Iwate Prefecture. (Japanese.) O. SHINJI. [Saitô Hô-on Kw. Hak. Zihô., No. **30** (1936), 2-5.] — 33 species belonging to 26 genera, 1 family and 3 subfamilies are listed. S. Ohfuchi.

102. A List of the Marine Shells from Yamagata Prefecture. (Japanese.) S. NOMURA and N. JINBÔ. [Saitô Hô-on Kw. Hak. Zihô., No. **30** (1936), 25–30] — 46 species of Pelecypoda, 2 species of Scaphopoda and 103 species of Gastropoda are listed. S. Ohfuchi.

103. Birds from North Eastern Hondo, Japan. II Report; Striges, Accipitres, Gressores, Anseres, Steganopodes, Tubinares, Pygopodes, Columbae, Limicolae, Lari, Alectorides and Galli. S. OHFUCHI. [Saitô Hô-on Kw. Mus. Res. Bull., No. **7** (1936), 1–141,

12 pls.] — 140 species and subspecies belonging to 86 genera, 21 families and 13 suborders are listed.   Author.

104. The Fresh-water Sponges obtained in Northeast Honshu, Japan. Nobuo SASAKI. [Saitô Hô-on Kw. Mus. Res. Bull., No. 9 (1936), 1–30, 8 text-figs. 4 pls.] — Many fresh-water sponges are collected by the writer in 1934 from lakes, ponds, ditches and rivers. 10 species are listed from Northeast Honsyû, i. e, *Spongilla lacustris* (L.), *S. semispongilla* (Annandale), *S. fragilis* Leidy, *S. sendai* n. sp., *S. hozawai* n. sp., *Ephydatia crateriformis* (Potts), *E. fluviatilis* (L.), *E. mülleri* (Lieberkühn), *E. mülleri* var, *japonica* (Hilgendorf), *Heteromeyenia baileyi* var. *petri* (Lauterborn). Of these 10 species, *S. sendai* and *S. hozawai* are new to science, and *E. crateriformis* is new to Japan, while the remaining 7 species are already known from Japan.
                                                                                        S. Ohfuchi.

105. Remarks on the Scyphomedusan Family Pelagidae. Tohru UCHIDA. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 42–45.] Systematic notes on Pelagidae of Japan.
                                                                                        Author.

106. Über japanische *Escaryus*-Arten. Yoshioki TAKAKUWA. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 46–50.] — Beschreibungen von drei neuen Arten, *E. yakumoensis, E. sachalinus, E. makizimae.*   T. Uchida.

107. Further Notes on Spiders from Southern Saghalien. (The Third Supplement.) Saburo SAITO. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 51-54.] — A record of 16 spiders hitherto unrecorded from Saghalien.   T. Uchida.

108. Spiders from the Northern Kurile Islands. II. Saburo SAITO. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 55–56.] — A list of 4 spiders new to Saghalien.
                                                                                        T. Uchida.

109. A List of Bird's Skin belonging to Anatidae kept in the University Museum of Sapporo. Marquis Yoshimaro YAMASHINA and Shinjiro IKEDA. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 57-67.] — A list of 33 species.   T. Uchida.

110. Über japanische *Queenslandophilus*-Arten. Yoshioki TAKAKUWA. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 131-135.] — Beschreibungen von zwei neuen Arten, *Q. trichochilus* und *Q. macropalpus.*   T. Uchida

111. A Peculiar Poison used by the Ainu for Bird Hunting. Tetsuo INUKAI. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 136–137.] — The Ainu use two kinds of plants, *Aconitum subcuneatum* and *Cynanchum Ikema*, as arrow poison. The latter plant is employed for hunting the Bering Island raven and the eagle. Some ethnological notes on this plant was given.
                                                                                        T. Uchida.

112. Zwei *Brachygeophilus*-Arten und eine *Pleurogeophilus*-Art aus Japan. Yoshioki TAKAKUWA. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 143–147.] — Beschreibung von *Brachygeophilus dentatus, B. koreanus* und *Fleurogeophilus aporus.*   T. Uchida.

113. Über Diplopoden aus Japan, gesammelt von Herrn Y. Takakuwa. K. W. VERHOEFF. [Trans. Sapporo Nat. Hist. Soc., 14 (1935), 148-172, Taf. 2.] — Beschreibungen von *Niponiella nodulosa, Takakuwaia furculigera* n. g. & n. sp., *Fontaria (Japonaria) falcifera* n. sp., *F. (J.) attemsii* n. sp., *F. (J.) coarctata acutidens, F. (Cyphonaria n. subg.) scabra* n. sp. *Orthomorpha circofera affinis* n. subsp., *Nedyopus tambanus mangaesinus, Epanerchodus, Hyleoglomeris (Perkeomeris* n. subsp.) *japonica* n. sp., *H. (P.) insularum* n. sp., *Fusiulus simplex* n. sp., *Syntelopodeuma formosanum* n. sp.   T. Uchida.

114. Zooplankton of Lake Taraika and its Neighbouring Waters, Southern Sak-

halin. Masuzo UÉNO. [Trans. Sapporo Nat. Hist. Soc., **14** (1935), 173-177, 5. pls.] — A list of species belonging to the Copepoda, Cladocera, Rotatoria, Protozoa and Insecta, with short remarks on 11 species.   T. Uchida.

115. On a New Species of *Liparis*. Shoichi NOJIMA. [Trans. Sapporo Nat. Hist. Soc., **14** (1935), 179-180.] — This species differs from *L. agassizii* in the dorsal fin, number of pyloric coeca, length of the maxillary and the longest ray of the pectoral.   T. Uchida.

116. Studies on Japanese Branchiobdellidae with some Revision on the Classification. H. YAMAGUCHI. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool. **3** (1934), 177-219, 2 pls.] — Historical review and remarks on taxonomic characters in the Branchiobdellidae. Classification and description of Japanese branchiobdellids represented by the following 19 species which contain 10 new species: *Branchiobdella orientalis* n. sp., *B. digitata* Pierantoni, *B. kobayashii* n. sp., *Camborincola okadai* Yamaguchi, *Stephanodrilus* (*St.*) *inukaii* n. sp., *St.* (*St.*) *aomorensis* n. sp., *St.* (*St.*) *ezoensis* n. sp., *St.* (*St.*) *megalodentatus* n. sp., *St.* (*St.*) *japonicus* Pierant., *St.* (*St.*) *koreanus* Pierant., *St.* (*St.*) *homodontus* (Yamaguchi), *St.* (*St.*) *makinoi* n. sp., *St.* (*St.*) *sapporensis* Pierant., *St.* (*St.*) *cohsen* n. sp., *St.* (*St.*) *nipponicus* (Yama.), *St.* (*St.*) *kawamurai* n. sp., *St.* (*St.*) *suzukii* n. sp., *St.* (*Ceratodrilus*) *uchidai* (Yama.) *St.* (*Cer.*) *cirratus* (Pierant.). Some ecological notes about locomotion, food, copulation etc. are given.   T. Uchida.

117. Studies on the Aquatic Oligochaetes of Japan. I. Lumbriculids from Hokkaido. H. YAMAGUCHI. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool. **5** (1936), 73-93, 2 pls.] — First record on the Lumbriculidae from Japan. Description of three new Lumbriculids; *Lumbriculus japonicus* n. sp., *Rhynchelmis orientalis* n. sp., and *Hrabea ogumai* n. g. et n. sp., with some ecological observations on the first species. In this species, genital organs are quite variable in number and position. The variation is described on 174 mature individuals.   T. Uchida.

118. Description of a New Polychaete, *Thoracophelia yasudai* n. sp. Shiro OKUDA. [Jour. Fac. Sci., Hokdaido Imp. Univ., Ser. VI, Zool. **3** (1934), 169-175.] — Description of a new sedentary polychaete, *Thoracophelia yasudai*, of the Opheliidae with some emendations on the genus *Thoracophelia*.   T. Uchida.

119. Some Tubicolous Annelids from Hokkaido. Shiro OKUDA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool. **3** (1934), 233-245.] — Six species of Sabellidae and Serpulidae referable to 5 genera are described, including two new species, *Hydroides ezoensis* and *Spirorbis nipponicus*.   T. Uchida.

120. Chaetopterids from Japanese Waters. Shiro OKUDA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool. **4** (1935), 87-102, 1 pl.] — Descriptions of 4 species of Chaetopteridae referable to 3 genera, *Chaetopterus variopedatus*, *Mesochaetopterus japonicus*, *M. minuta* and *Telepsavus costarum*, the last 2 species having been newly reported from Japan. Detailed accounts on 2 forms of *Chaetopterus variopedatus* due to different habitats.   T. Uchida.

121. On the Amami Spinous Rat (*Rattus jerdoni osimensis*, Subsp. nov.) with Special Remarks upon its Spines. Yoshio ABE. [Jour. Sci., Hiroshima Coll. Lit. and Sc., Ser. B, Div. 1, **9** (1934).] — Spinous rat, which is rarely found in the island of Amami-Osima, one of the Riukiu Islands, was studied from the taxonomic point of view. Anatomical data of the skull, hair and spines are also given.   S. Inuo.

122. The Larva of the Catfish, *Parasilurus asotus* L. Kenji ATODA. [Sci. Rep. Tôhoku Imp. Univ., IV, Biol., Sendai, **10** (1935).] — Japanese catfish has two pairs of barbels in adult stage and it has been thought that it possesses the two pairs of barbels throughout its life. To our astonishment, it was revealed that the young catfish, less than 6 cm in body length, bears three pairs of barbels. The second mental barbels fall off spontaneously in the fishes about 6 to 7 cm long.   S. Inuo.

123. On the Histogenesis of the Islands of Langerhans in *Rana japonica* (Günther).
Kunio HIROTA. [Sci. Rep., Tôhoku Imp. Univ., IV, Biol., Sendai, 9 (1934).] — The larvae of
R. j. were selected as the material for investigation. The fixation of the material was begun
2 days after the hatching and repeated at intervals of every 3 days for 20 days and then at
desired stages till the complete absorption of the tail. The pancreas of the adult was also pre-
served for comparison with those of the larvae. The serial sections were made and the de-
velopmental stages of pancreas were observed in each stage. S. Inuo.

124. Histologische Studien über die Giftdrüsen von *Trimeresurus flavoviridis*
(Japanisch.) Mitsuo FUKUDA. [Kumamoto Igk. Z., 11 (1935), 117-124, 1 Taf.] — Die
Giftdrüsen der genannten Schlange sind verästelte tubuläre Drüsen. Die einschichtig angeordneten
Drüsenzellen sind zylindrisch oder kubisch, und bieten ein dem Übergangsepithel ähnliches Aus-
sehen dar. Der Golgische Apparat liegt im distalen Abschnitt der Drüsenzellen und stellt ein
aus feinen Fäserchen zusammengesetztes Netzwerk dar. Die Plastosomen bestehen aus Körnchen
und nehmen ihren Sitz ebenfalls im distalen Teile der Zelle. T. Fujita.

125. Ein Beitrag zur Kenntnis über die Bindegewebefasern der Lymphknoten.
(Japanisch.) Syuji GOTO. [Dainihon Jibi Kh., 41 (1935), 872-875.] — Durch histologische Unter-
suchungen der Halslymphknoten des Kaninchens kam Verf. zu dem Schluss, dass die Knotenkapsel
vorwiegend aus kollagenen, ergänzend aber auch aus elastischen Fasern aufgebaut ist, wahrend
das Parenchym in der Hauptsache die Gitterfasern enthält. In Bezug auf die wichtige Rolle,
welche die membranartig angeordneten Gitterfasern der Lymphraumwand abspielen könnte,
schliesst sich Verf. an die Meinung von Jeremiah und Ferguson an. T. Fujita.

126. Über Glykogen und Milchsäure im Knorpelgewebe. (Japanisch.) Aritosi IKUTA.
[Fukuoka Ik. Daig. Z., 27 (1935), 375-405, 1 Taf] — Chemische und mikrochemische Untersuchungen
an gesunden und Rachitis-kaninchen. Material: Rippenknorpel als Vertreter der nicht verknöchern-
den Knorpel und Epiphysenknorpel der extremitäten Knochen, insbesondere des Femur, als Ver-
treter der verknöchernden Knorpel. Resultat: Das Glykogen im nichtverknöchernden Knorpel
ist viel stabiler als dasselbe im verknöchernden Knorpel. Der Glykogengehalt des ossifizierenden
Knorpels ist dem Alter nach verschieden, er ist grösser bei jüngeren Tieren. Beim Rachitistiere
tritt eine deutliche Glykogenablagerung in der Ossifikationszone auf. Die Auflösbarkeit des Gly-
kogens ist dabei herabgesetzt im Vergleiche mit dem Normalzustand, die Blutdiastase zeigt indes
keine Veränderung. Der ossifizierende Knorpel enthält weniger Milchsäure als der nonossifizie-
rende Knorpel. Der Milchsäuregehalt des verknöchernden Knorpels nimmt rasch zu nach dem
Abtöten des Tieres, während es beim nichtverknöchernden Knorpel niemals der Fall ist. Man
könnte daraus annehmen, dass das Kohlenhydratstoffwechsel im Knorpel zwischen dem Glykogen
und der Milchsäure stattfindet. Beim Rachitis-kaninchen ist die bedeutende Zunahme der Milch-
säure im verknöchernden Knorpel wahrzunehmen. Im normalen Zustand ist der verknöchernde
Knorpel mehr alkalisch als der nichtverknöchernde Knorpel, während bei Rachitis auch der ver-
knöchernde Knorpel sich nach säuer schiebt. T. Fujita.

**127. Action of Formosan Snake Venoms on the Development and the Form of
the Fibroblasts.** (Japanese.) Kaduo MATUMOTO. [Taiwan Igk. Z., 34 (1935), 364-372, 1
pl.] — The venoms of *Trimeresurus macrosquamatus* (Cantor), *Trimeresurus graminens* (Shaw),
Naja naja atra (Cantor), *Agkistrodon acutus* (Günther), and *Bungarus multicinctus* (Blyth) were
brought in the glass-covered culture of the cardiac fibroblasts of chick embryo. The venoms of
the first four species displayed a remarkable impeding action upon the development of the fibro-
blasts, while that of the last species showed a weaker effect. The morphological changes of
fibroblasts through the toxic action of these venoms were different. The venoms of *Trimeresurus
macrosquamatus* and *Agkistrodon acutus* for instance had their chief action in rounding the cells,
while the venom of the *Naja naja atra* showed above all the cytolytic effect. T. Fujita.

**128. Zytologische Untersuchungen über die Langerhansschen Inseln des *Bufo
vulgaris japonicus.*** (Japanisch.) Katsumi MORI. [Nagasaki Igk. Z., 13 (1935), 824-833, 2 Taf.]
— Auch bei diesen Tiere bestehen die L.-schen Inseln aus zweierlei Zellenarten. Die eine, welche

heller aussieht, stellt den Hauptteil der Inseln dar, während die andere dunklere mehr in der Peripherie der Inseln liegt. Da diese beiden Arten ·der Inselzellen gleichsam die Plastosomen, Granula, Vakuolen und Golgi-Apparate in sich nachweisen lassen, so könnte man annehmen, dass sie beide an die Sekretionstätigkeit beteiligt sind. Der zytologischen Beschaffenheit nach dürften jedoch die beiden Zellarten jeden für sich eine eigene Sekretionsfunktion besitzen. Irgendein Übergangsbild dieser zwei Zellarten war immer festzustellen. T. Fujita.

129. Über die basalgekörnten Zellen im Darmepithel. (Japanisch.) Katsumi MORI. [Nagasaki Igk. Z., 13 (1935), 929-939, 1 Taf.] — Material: *Pithecus cyclopsis, Felis domesticus, Sus scrofa domestica, Cavia cobaya* und *Orectolobus japonicus* (eine Art Selachier). Die basalgekörnten Zellen von Clara, welche auch im Duodenum des *Orectolobus japonicus* nachgewiesen werden konnten, kommen im Schweindarm am reichlichsten vor. Sie sind im allgemeinen im Bereiche des Duodenums am dichtesten verteilt und vermindern allmählich nach analwärts hin. Davon macht aber die Katze insofern eine Ausnahme, als bei diesem Tiere der Dickdarm am meisten mit den Zellen versehen ist. Es ist auch eine Regel, dass die betreffenden Zellen reichlicher an Lieberkühnschen Krypten als an Zotten vorkommen. Die Zellen sind meistens zylinderisch, können aber, der Umgebung anpassend, Flaschen-, Kolben-, oder Birnenform aufnehmen. Der Kern ist rund und chromatinarm. Der Golgi-Apparat liegt wie bei den Hauptzellen ausnahmlos supranukleär. Die intrazelluläre Verteilung der Körnchen ist je nach der Tierart verschieden, so zum Beispiele sind die Körnchen bei Affen und Schwein als Regel infranukleär aufzufinden, während dieselben bei Meerschweinchen und Katze fast den ganzen Zellleib ausfüllen. Die Menge der Körnchen unterliegt selbst bei einem und demselben Tiere einer Schwankung, was wahrscheinlich mit dem Sekretionszyklus zusammenhängt. T. Fujita.

130. Über den Einfluss der Parotis-Exstirpation auf Schilddrüse, Uterus und Ovarium. (Japanisch.) Yasuo OHMAGARI. [Kyûshû Shika Gk. Z., 3 (1935), 116-142.] — Die Ratten, deren Parotis beiderseits total exstirpiert wurden, zeigten in 3 Wochen anatomische und histologische Veränderungen in verschiedenen Organen: Schilddrüse geriet in Pseudohypertrophie; Uterus war hyperämisch angeschwollen mit allgemeiner Fettinfiltration, Atrophie der Drüsenzellen und Stauung der Blutgefässe; das Ovarium zeigte auch Stauung bzw. Hyperämie, jedoch ohne nennenswerten Veränderungen der Follikeln. T. Fujita.

131. Über die Lichtabsorption der verschiedenen Gewebe. (Japanisch.) Hidekiyo OKAMURA, Kanshi TAKAGI u. Masami TAKEHISA. [Mitt. Med. Akad., Kyôto, 16 (1935), 435-442 (694-695).] — Das Lichtabsorptionsvermögen der verschiedenen Gewebe wurde mittelst des Mikrophotometers untersucht. Als Material dienten die Gewebe des Kaninchens, die mit 10% Formalin fixiert und in 50 μ Dicke geschnitten wurden. Die Durchsichtigkeit ergab sich in der folgenden Reihe: weisse Substanz des Rückenmarks>Marksubstanz des Ovariums>weisse Substanz des Kleinhirns>Medulla obl.>weisse Substanz des Grosshirns>Leber>Milz>graue Substanz d. Rückenmarks>Nierenrinde>graue Substanz d. Kleinhirns>Skelettmuskel>Herzmuskel >Zungenmuskel>Marksubstanz der Niere>Muskulatur der Magenwand>graue Substanz des Grosshirns>Lunge>Rindensubstanz des Ovariums. Die Durchsichtigkeit der Gewebe beruht auf den physikalisch-chemischen Eigenschaften des Gewebes einerseits und auf der morphologischen Aufbau der Gewebselemente. Es wurde eine Korrelation zwischen der Durchsichtigkeit und dem spezifischen Pulvergewicht (nach K. Kushida) des Gewebes festgestellt. T. Fujita.

132. Über Binnennetzapparat der Linse. (Japanisch.) Kunitoshi OSAKI. [Kumamoto Igk. Z., 11 (1935), 1615-1619.] — Die vorliegende Untersuchung wurde an Kaninchen- und Hundelinse vorgenommen. An den Epithelzellen der Linse konnte der Binnennetzapparat nachgewiesen werden, der aus Fäserchen bestehendes, glomerulusförmiges Gerüstnetz darstellt und sich in der Nähe des Kernes findet. In der Umgebung des Kernes der Linsenfasern war dagegen der Apparat nicht wahrzunehmen. T. Fujita.

133. Über die Veränderungen der Nebenniere und der anderen Organe bei schwangeren Kaninchen. (Japanisch.) Etudi SANO. [Jûzenkwai Z., 40 (1935), 86-92.] — Die Nebenniere nimmt ihr Gewicht etwas zu. Die Zona glomerulosa wird dicker, während die Z. fasciculata und reticularis dünner werden, mit gleichzeitiger Zunahme der Fettkörper. In der

Zona glomerulosa sind viele mitotische Bilder zu sehen. Hypophyse, Schilddrüse, Milz, Herz, Leber und Niere nehmen ihr Gewicht zu, während das Gewicht des Thymus abnimmt.

<div align="right">T. Fujita.</div>

134. Über den Einfluss der Ovariumexstirpation auf die Nebenniere. (Japanisch.)

Etudi SANO. [Juzenkwai Z., **40** (1935), 67-84, 1 Taf.] — Aus einer Reihe der Experimente am Kaninchen hat sich das Folgende ergeben: Durch die Wegnahme der Ovarien vermindern sich das Gewicht und die Grösse der Nebenniere. Es wird die Rinde dünner und viel Fettkörper wird da abgelagert, was mit regressiven Veränderungen der Rindenzellen, Verdickung der Kapsel und Hypertrophie des Interstitiums einhergeht. Auf den Markzellen tritt keine nennenswerte Veränderung auf. Die Exstirpation der Ovarien hat ausserdem noch verschiedene Einflüsse auf den ganzen Körper sowie auf einzelne Organe, so z. B. Zunahme d^es Körpergewichtes (Fettsucht), Hypertrophie der Hypophyse, des Thymus, der Schilddrüse und der Leber, Atrophie des Uterus, der Milz, der Niere und des Herzens etc.

<div align="right">T. Fujita.</div>

135. Über die Bestimmung der Flimmerbewegung beim Regenerationsvorgang des Flimmerepithels. (Japanisch.)

Aisaburo SEO. [Fukuoka Ik. Daig. Z., **28** (1935), 1590-1615.] — Eine ganze Reihe der Regenerationsversuche an Flimmerepithel des Froschgaumens sowie der Kaulquappenschwanz hat den Verfasser zu dem folgenden Schluss geführt: Für die Bestimmung der Bewegungsrichtung der Flimmern sind zwei Faktoren anzunehmen. Der eine ist von den Mutterzellen der regenerierenden Flimmerzellen getragen und stellt das primäres Element dar. Der andere besteht dagegen in den verschiedenartigen Bedingungen, welche sich ausserhalb der Mutterzellen abspielen. Dieser kann also als ein sekundäres Element betrachtet werden.

<div align="right">T. Fujita.</div>

136. Über die feinere Struktur der Ameloblasten und Odontoblasten. (Japanisch.)

Kanji TAKAHASHI. [Kôkû. Gk. Z., **9** (1935), 95-103, 232-250, 5 Taf.] — Als Untersuchungsmaterial dienten Schneidezähne der Maus. Die dargestellten mitochondrien, Golgische Apparate, Granula und Vakuolen sind auf den beigefugten Tafeln schon wiedergegeben. In Serienschnitten der Zellen konnte Verf. feststellen, dass diese corpuskuläre intrazellulare Elemente (abgesehen von Golgischen Apparaten) miteinander verbunden sind. Aus dieser Tatsache möchte Verfasser den Amelo- und Odontoblasten eine Art sekretorischer Eigenschaften zuschreiben. Die feine intrazelluläre Gebilde waren an dem Zahnkeime schwer darzustellen, das die Verkalkung noch nicht angefangen hatte. Dagegen waren sie gut entwickelt am Schneidezahn der erwachsenen Tiere. Mit der Rückbildung der Amelo- bzw. Odontoblasten zeigten auch die genannte Elemente Vereinfachung ihres Gefüges und Verkleinerung ihrer Grösse, um allmählich zu verschwinden. Ferner wurden an den Zellen der sog. intermediären Schicht, die den Ameloblasten unmittelbar anliegen, eine ähnliche intrazelluläre Struktur wie der Ameloblasten wahrgenommen, woraus geschlossen werden könnte, dass diese Zellen funktionell mit den Ameloblasten in enger Beziehung stehen.

<div align="right">T. Fujita.</div>

137. Über die pyroninophile Gebilde der Leberzellen von *Diemyctylus pyrrhogaster*.

(Japanisch.) Susumu TAKETOMI. [Nagasaki Igk. Z., **13** (1935 , 1131-1145.] — Die pyroninophilen Gebilde der Leberzellen sind gespeicherte Eiweisskörper und haben den Nukleolen ähnlichen chemischen Zusammenhang. Sie farben sich nicht nur mit Methylgrünpyronin, sondern auch mit Toluidinblau in gleichem Farbenton wie die Nukleolen. Diese beiden Gebilde haben jedoch funktionell einen Zusammenhang, weil jene beim Fasten vollständig verschwinden können, während diese (Nukleolen) dabei ganz unverändert bleiben. Aus diesem Resultate möchte Verf. im wesentlichen der Ansicht von Berg, Clara u. a. bestimmen.

<div align="right">T. Fujita.</div>

138. Embryologische Studien über die Hypophysis cerebri der Kröte (*B. formosus*).

(Japanisch.) Kensei TERATO. (Kumamoto Igk. Z., **11** (1935), 591-630, 9 Taf.] — Eine ausführliche Beschreibung der einzelnen Stadium der Entwicklung der Hypophyse.

<div align="right">T. Fujita.</div>

139. Über die Zahnformel des japanischen Maulwurfes (*Mogera wogura*). (Japanisch.)

Toshikazu TOKORO und Suteo MISAWA. [Nihon Shika Gk. Z. **28** (1935), 467-470.]

— Aus makroskopischem Befunde an 10 Maulwurfschädeln schliessen die Verff. auf I $^3/_3$, C $^1/_0$, P $^4/_4$, M $^3/_3$=42 als die Zahnformel von *Mogera wogura*. (cf. Talpa: I $^3/_3$, C $^1/_1$, P $^4/_4$, M $^3/_3$=44 nach Owen.) T. Fujita.

140. Ein Beitrag zur Kenntnis der Fibroblastenreinkultur. (Japanisch.) Syôzô TSUJI. [Nihon Biseibutsu-Byori Gk. Z., 29 (1935), 375-384.] — Die sog. Reinkultur der Hühner-fibroblasten (aus dem embryonalen Herzen) zeigte bei Fortzüchtung mit taurocholsäurem bzw. oleinsäurem Natron keine Vitalfärbbarkeit gegenüber Lithionkarmin und Tusche. Selbst an der 10. Generation der Fortzüchtung konnten immer noch histiozytäre Zellen auftreten, woraus folgert sich, dass die sog. Reinkultur nach Carrel u. Ebeling sowie nach Fischer in Wirklichkeit nicht ganz rein sein kann. Die Hühnerfibroblasten können sich beim Vorhandensein von taurocholsäurem oder oleinsäurem Natron nicht in die Makrophagen umwandeln. T. Fujita.

141. Über den Einfluss des Ozongases auf den Oxydations- und Reduktionsort sowie die Oxydasereaktion der Gewebe. (Japanisch.) Shigeru UMEDA [Mitt. med. Akad. Kyôto, 16 (1935), 748-756, 1071-1072.] — Das Ozongas wurde erwachsenen, weiblichen Kaninchen subkutan 10 ccm pro Kg injiziert und nach 1/6, 1/2, 1, 3, 4 und 24 Stunden wurden verschiedene Organe zu den Untersuchungen herangezogen. So übte die Ozongasinjektion einen gewissen Einfluss auf den Oxydations- und Reduktionsort sowie auf die Oxydasereaktion der Gewebe aus. Dieser Einfluss kann an den Muskeln der Gegend, wo die Injektion erfolgte, am deutlichsten zu Tage, dann der Reihe nach ander, Leber, Niere und der Schilddrüse. Derselbe erreichte den Höhepunkt 1 Stunde nach der Injektion, um in 4 bis 24 Stunden völlig abzuklingen. T. Fujita.

142. Physiko-chemische Studien über Gewebefärbungen. (Japanisch.) Tatuya URA-KAMI. [Nihon Biseibutsu-Byorigakkai Z., 29 (1935), 336-356, 456-479.] — Die umfangreiche Arbeit besteht aus 2 Abschnitten: 1). Isoelektrische Punkt der gesamten normalen Gewebe bei Kaninchen, Ratte und Maus wurde systematisch untersucht unter Benutzung von Methylenblau und Krystallponceau als Pufferlösung. Aus den gewonnenen Resultaten, die sich im Grossen und Ganzen mit den Einzelangaben der früheren Autoren decken, lässt sich folgendermassen zusammen-fassen: IEP variert mit der Frischheit des Gewebes, mit der Art der Fixierungsflüssigkeit und auch damit, ob das Material fixiert oder nicht fixiert ist. IEP des Kernes steht im allgemeinen mehr auf Säureseite (im Mittel pH=3,0) als derselbe des Protoplasmas (pH=5,07). Mit der Differenzierung des Gewebes schiebt sich IEP nach alkalisch (sowohl beim Kerne wie beim Protoplasma). IEP kann auch mit dem Funktionszustand des Gewebes varieren, so z. B. bei Darmepithel. 2). Über die Sauerstoff- und Reduktionsorte nach Unna. Nach Verfassers Ausein-andersetzungen sollen die Sauerstofforte nicht das wirkliche Oxydationsvermögen der betreffenden Gewebe darstellen, so auch die Reduktionsorte nicht immer dem Manganbild entsprechen. Ver-fasser machte deshalb einen Vorschlag, den Begriff von Sauerstoff- bzw. Reduktionsorten mit dem pH-Wert des IEP zu ersetzen. T. Fujita.

143. Entwicklungsgeschichtliche Untersuchungen über das Kopfskelett von *Agkistrodon blomhoffi* Boie. (Japanisch.) Shôhei ADATI. [Kaibô. Z., Tôkyô, 8 (1935-36), 161-256, 5 Taf.] — (1) Der neurale Teil entwickelt sich früher als der viszerale. (2) Am Neuro-cranium wird zuerst die Gewebsverdichtung im Occipitalbogen der Basalplatte beobachtet. (3) Das Planum basale liegt hypochordal. (4) Das Primordialcranium ist platybasisch. (5) Die Crista sellaris, die Alisphenoidplatten und die Parachordalia entstehen aus einer gemeinsamen Mesenchymverdichtung. (6) Das Foramen X von Bäckstroem ist vorhanden. (7) Die Anlage der Ohrkapsel kommt am ventralen Umfang der Ohrblase vor. (8) Die Fenestra basicranialis post. kommt auch vor. (9) Das perilymphatische System kommuniziert durch die Foramina peri-lymphatica superius und inferius mit der Cisterna perilymphatica und dem Cavum subarach-noideale. (10) Als Deckknochen zählt man am Neurocranium des Tieres von 220 mm Körperlänge 24 Stücke: 1 Prämaxillare, je 2 Nasalia, Maxillaria, Platina, Transversa, Pterygoidea, Septomaxil-laria und 1 Praefrontalia und 1 Frontale. Als Ersatzknochen 18: Je 1 Basisphenoid und Basi-occipitale und je 2 Alisphenoida, Pleurooccipitalia, Supraoccipitalia, Prootica, Epiotica, Opisthotica, Quadrata und Articularia. Am Unterkiefer findet man ferner als Deckknochen Dentale, Supra-angulare und Goniale und als Ersatzknochen Operculare und Angulare. S. Nishi.

144. Die Schicksal der Kiemenhöhle von *Bufo vulgaris japonica.* (Japanisch.) Tôhei AOI. [Kaibô. Z., Tôkyô, **8** (1935-36), 1247-1258, 2 Taf.] — (1) Das rechtsseitige Perforationsloch wird im Operculum dort gebildet, wo sich die Hand bei gespreizter Lage des Ellbogens befindet. Es bildet sich durch natürliche Selbstdifferenzierung, wobei die Vorderextremität nur die Rolle eines Nebenfactors zu spielen scheint. (2) Der die eigentliche Kiemenhöhle bedeckende Teil des Operculums degeneriert und wird absorbiert, während der Teil des Verbindungsstückes erhalten bleibt. (3) Die Degenerationsphänomene beginnen beim rechten Operculum am Rande des Perforationsloches, beim linken an der Spitze des Spiraculums. Das durch den Schwund des Operculums blossgelegte innere Epithel der Kiemenhöhle verwandelt sich in mehrschichtiges Plattenepithel. Im zurückgebliebenen Teil des Operculums entwickeln sich die aus dem äusseren Epithel abstammenden, mehrzelligen Drüsen immer kräftiger und zahlreicher, während der aus dem Epithel der Kiemenhöhlenwand gebildete Verbindungskanal sich allmählich obliteriert und verschwindet.   S. Nishi.

145. Eine entwicklungsgeschichtliche Studie über die Kiemenhöhle des *Bufo vulgaris japonicus.* (Japanisch.) Tôhei AOI. [Kaibô. Z., Tôkyô, **8 (1935-36), 501-519, 3 Taf.] — Die Entwicklung der Kiemenhöhle, des Spiraculums und des Operculums von *B. v.* ist eingehend an den Larven von 9-22 mm Körperlänge eventuell durch Plattenmodellrekonstruktion eingehend verfolgt. Nicht zu einem kürzeren Referat geeignet.   S. Nishi.

146. Beobachtungen über die Entstehung des Vornierenganges. II. Bei den Vögeln, besonders bei den Embryonen von *Anas domestica.* (Japanisch.) Junzô DANJO. [Okayama Igk. Z., **47 (1935), 102-127.] — 1) Bei den Embryonen mit 10 Ursegmenten erscheint am 7-8 Segmente, die erste linke Anlage des Vornierenganges welche kaudalwärts zur kaudalen Partie des 10 Segmentes hinabreicht. Die erste Anlage der Vorniere findet sich schon am 1 oder 2 Ursegmente der Embryonen mit 3 Ursegmenten. Die Atrophie und der Schwund des kranialen Abschnittes der linken Vornierenanlage tritt an den Embryonen mit 7-8 Ursegmenten ein. Der Vornieren- und Urnierengang sind regionär verschieden, lassen sich aber nicht scharf gegeneinander abgrenzen.   S. Nishi.

147. Über experimentell erzwungene Lückenbildung am Operculum und vorzeitige Entbindung der Vorderextremität bei der Bufo-Larve. T. FUKAI. [Fol. Anat. Jap., Tôkyô, **13** (1935), 1 12.] — Bei der normalen Entwicklung von B. zeigt die rechte Seite eine Priorität der Entbindung der Vorderextremität in ca. 92.4%. Die Transplantation der Schwanz- und Beinknospe in die linke Kiemengegend rief eine Lückenbildung am Operculum der betreffenden Seite oder sonst eine Gestaltanomalie des Spiraculums hervor; durch diese Lücke oder dieses abnorme Spiraculum entband sich die linke Extremität immer vorzeitiger als die rechte. Die Elimination des Ektoderms der linken Kiemengegend hatte eine ähnliche Entwicklungsanomalie des Operculums und demgemäss eine vorzeitige Entbindung der Extremität der betreffenden Seite zur Folge. Bei der Transplantation der Schwanzknospe in die rechte Kiemengegend zeigte sich die gleiche Entwicklungsanomalie des Operculums. Die Lücke erstreckte sich aber in diesem Fall zur anderem Seite hinüber oder trat nur an der Gegenseite auf. Das mechanische Hindernis könnte dabei das fortschreitende Wachstum der Opercularfalte von rechts nach links bis zur Verwachsung mit der ventralen Bauchwand hemmend beeinflussen. Das Perforationsloch wurde unabhängig von dem Vorhandensein der Lücke gebildet; das Spiraculum wurde dagegen nirgend mehr gesehen, wenn die Lücke sich am Operculum befand.
S. Nishi.

148. Experimentelle Beiträge zur Blutgefässbildung bei Amphibienlarven. T. FUKAI. [Fol. Anat. Jap., Tôkyô, **13** (1935), 631-714.] — I. Eliminationsversuche an *Bufo-* und *Rhacophorus-*larven. Elimination von Vasa caudalia, V. jugularis und A. carotis externa: — Ihre Wiederherstellung findet durch rasche Bildung einer neuen Hauptbahn statt, welche eine Seitenbahn, eine Verbindungsbahn oder aber ein selbständiges Blutgefäss sein kann, was von der Art des Blutgefässes, dem topischen Verhalten, der Eliminationsstelle, der Art der Elimination usw. abhängig ist. Der Entstehungsprozess dieser neuen Bahn ist auch von dem Entwicklungsstadium abhängig. In einem etwas späteren Stadium entsteht sie durch rasche Umgestaltung der Zweige

oder Kapillaren, die schon bei Operation existierten; in einem möglichst frühen Stadium entsteht sie durch Neubildung der Zweige oder Kapillaren, sich dann zur Hauptbahn umgestalten. II. Homoio- und xenoplastische Transplantationsversuche an *Bufo-* und *Diemyctylus-*larven. Transplantation der Schwanzknospe und der Hinterbeinanlage:— Die Entwicklung der Blutgefässe im Transplantate, besonders ihre Genese, ihre Verhalten, ihre Verbindung, ihre Zirkulation usw. sind stets von der Art der Transplantation oder des Transplantates, der Transplantationsstelle, dem Entwicklungsstadium des Wirtes oder des Transplantates bei der Operation usw. anhängig. III. Variationsversuche mit den Blutgefässen:— Verf. vermochte die äussere Schwanzvene, welche bei *Rana-* oder *Rhacophorus-*larven regelmässig nachweisbar ist, auch bei *Bufo-*larven experimentell zu erzeugen, und die obere Schwanzvene, welche bei der Unkenlarve normal vorkommen soll, bei *Rana-*larven experimentell zu bilden. Endlich sind die experimentell erzeugten Varietäten, wie die der Schwanzgefässen, Queranastomose zwischen beiden Jugularvenen, mit den natürlich entstandenen verglichen.   S. Nishi.

149. Ein experimenteller Beitrag zur Entwicklung des Pigmentflecks der Anuren.
T. FUKAI. [Fol. Anat. Jap., Tôkyô, 13 (1935), 715-718.]— Der Pigmentfleck Waldeyers im kaudalen Körperabschnitt des Frosches entsteht bei der Transplantation des Schwanzes auch an der Transplantationsstelle. Diese Tatsache bestätigt nicht nur die Angabe von Kopsch, nach der der Pigmentfleck sich aus dem Rest des Kaulquappenschwanzes entwickelt, sondern beweist auch, dass das anatomische Verhalten des kaudalen Körperabschnittes für die Pigmentbildung nicht ausschlaggebend ist.   S. Nishi.

150. Embryologische Untersuchungen über die Nasenhöhle der japanischen Kröte
(**Bufo formosus**). (Japanisch.) Yasuo FUKUCHI. [Kaibô. Z., Tôkyô, 81 (1935- 36), 972-1014.] —(1) Die Nasenhöhle hat 2 genetisch abgetrennte Anlagen: die sog. Riechplatte und das Verbindungsstück, welches in der unmittelbar kaudolateralen Seite der ersteren als eine kleine Verdickung der Epidermis auftritt. Das Riechbläschen lässt zuerst den Recessus lateralis, dann den Rec. medialis und schliesslich das Cavum mediale differenzieren, während es selbst das cavum principale darstellt. Das Cavum inferius wird prinzipiell vom Rec. med. gebildet. (2) Man unterscheidet 2 Arten von Choana: die primäre, welche sich später zurückbildet, ist die orale Mündung des Verbindungsstückes, wahrend die sekundäre, welche die Übergangsstelle des Verbindungsstückes in das Cavum principalis darstellt, sich weiter entwickelt und in die eigentliche Choana umgebildet wird.   S. Nishi.

151. Beiträge zur wissenschaftlichen Anatomie des Nervensystems. Goichi HIRAKÔ.
[Fol. Anat. Jap., Tôkyô, 13 (1935). 561–566, 3 Taf.] — 1) Demonstration der Purkinjeschen Zellen des Kleinhirns, die durch Weigert-Palsche Markscheidenfärbung dargestellt sind. Durch die genannte, allerdings etwas modifizierte Methode konnte Verf. die Purkinjeschen Zellen des Hühnerkleinhirns elektiv färben, und ihre Fortsätze bis zur Oberfläche der Rinde kontinuierlich in Detail sichtbar machen.   S. Nishi.

152. Über die Fasern, insbesondere die corticalen extrapyramidalen, aus den Areae 8 (α, β, γ, δ) und 9 (c, d) der Grosshirnrinde beim Affen. Ko HIRASAWA und Kingo
KATOH. [Fol. Anat. Jap., Tôkyô, 13 (1935), 189–217.] — An 3 Formosa-Makaken und 1 *Cercopithecus* sind die genannten Areae Vogts mit einem diathermischen Apparat kauterisiert und 2-3 Wochen nach der Operation sind die Gehirne mikroskopisch durchforscht. 1) Die Fasern, welche von den genannten Rindenfeldern entspringen, lassen sich in die Assoziations-, die Kommissuren- und die Projektionsfasern einteilen. Die letzteren gehören zum grossen Teil zu den kortikalen extrapyramidalen, zum kleine Teil aber zu den pyramidalen Fasern, welche wahrscheinlich wenigstens z. T. die zentralen Bahnen der Augenmuskelnerven darstellen. Die extrapyramidalen Fasern ziehen zum Caput nuclei caudati Putamen, Pallidum, Thalamus, der Zona incerta, den Forel'schen Feldern und wahrscheinlich auch dem Nucleus ruber, Stratum intermedium pedunculi, der Substantia nigra, der medialen Haubenfussschleife und den Nuclei pontis.   S. Nishi.

153. Über die Fasern, insbesondere die kortikalen extrapyramidalen aus der Area 6 (α, β) der Grosshirnrinde beim Affen. (Japanisch.) Ko HIRASAWA und Kingo

KATOH. [Kaibô Z., Tôkyô, 8 (1935-36), 613-630.] — Untersuchung durch Kauterisierung der genannten Area bei einem Exemplar aus Polynesien. Hier findet man Assoziations-, Kommissuren- und Kortikofugalen Projektionsfasern; die letzteren gehören zum grossen Teil zu den kortikalen extrapyramidalen, aber zum kleinen Teil auch zu den pyramidalen Fasern, we'che mit grosster Wahrschein'ichkeit diejenigen der Augenmuskelnerven darstellen. Als kortikale extrapyramidale Fasern sind folgende Arten zu nennen: Fasern zum Caput nuclei caudati, Pallidum externum, P. internum, Stratum intermedium pedunculi und zur Substantia nigra, sowie die Fasern zur medialen Haubenschleife und zum Tractus frontopontinus. Hier findet also die Ansicht Hirasawas, nach der die Grosshirnrinde einen direkten Anteil des extrapyramidalen Systems darstellt, völlige Bestätigung. S. Nishi.

154. Studies on Mitochondria and Metachondria of the Epithelial Cells of the Uterus and the Vagina.
Genkichi HONDA. [Jap. J. Exp. Med., Tôkyô, 13 (1935), 31–57, 1 Pl.] — The work consists of following 5 chapters:—1) Mitochond la and Metachondria (Mitamura) of the epithelial cells of the uterus and the vagina of the normal white rat. 2) Influence of the parentally introduced follicular fluid, Corpus luteum and anterior lobe cell constituents of the pitutary gland on the mitochondria and metachondria of the uterine mucous and the vaginal epithelial cells. 3) Influence of the parentally introduced endocrine gland cell constituent on the mitochondria and metachondria of the epithelial cells of the uterus and vagina. 4) Influence of the parentally injected mucous and the vaginal epithelial cell constituent on the mitochondria and metachondria of the epithelial cells of the uterus and the vagina. 5) Influence of various kinds of drugs on the mitochondria and metachondria of the epithelial cells of the uterus and the vagina. S. Nishi.

155. Über die elektrostatische Ladung des Augapfels. I. Über den isoelektischen Punkt des Augapfels des Herbstfrosches.
S. IKEDA. [Fol. Anat. Jap., Tôkyô, 13 (1935), 141–145, 1 Taf.] - Durch Farbung von Serien verschieden gepufferten Farblosungen und durch Bestimmung der Färbungsintensität, wu den die i-oelektrischen Punkte des Augapfels des Herbstfrosches bestimmt. Demnach verschiebt sich der isoelektrische Punkt der Aussen- und Innenglieder des Stabchens des Hellfrosches weiter auf die saure Seite als derjenige des Dunkelfrosches, sodass es nunmehr ohne Bedenken behauptet wird, dass dieser Teil der Netzhaut unter dem Einfluss des Lichtes seine negative Ladung vermehrt. S. Nishi.

156. Studien über die Bildung von Kapillaren durch Endothelzellen.
(Japanisch.) Kwan ISHIGAMI. [Aichi Igk. Z., Nagoya, 42 (1935), 1 61, 7 Taf.] — Die Arbeit besteht aus 3 Abschnitten: 1) Über die spezielle Fahigkeit der Endothelzellen der Blutgefasse, Kapillaren zu bilden. 2) Über das Verhältnis der Konzentration der Wasserstoffionen des Nahrbodens zu der Bildung von Kapillaren. 3) Über die Bildung neuer Kapillaren in einer „transpa ent chamber". Für die Kultur in vitro benutzte er kleine Gefässe der Huhnerallantois und für die Kultur in „transparent chamber" nach Sandison and Clark wendete er Blutgefässe des Kanincheohrs an. Die Bildung der Kapillaren durch Endothelzellen geschieht zunachst durch ihre spezielle Fahigkeit, dann durch geeignete Bedingungen im ungebenden Medium und durch Existenz des Blutes im Gefäss. Als intravaskuläre Bedingungen sind Momente notwendig, die den Kreislauf verzogern, als extravaskuläre Momente, die die Ionenkonzentration im Gewebe verandern. Am Anfang der Kapillarenentwicklung ist der Kreislauf nicht absolut notwendig, in der weiteren Entwicklung dagegen absolut notwendig. S. Nishi.

157. Über die Hämolysenerscheinung von dem feineren Bau der Blutzellen betrachtet.
(Japanisch.) Matsunosuke IZUMI. [Kaibô. Z., Tôkyô, 8 (1935-36), 679–707, 3 Taf.] — Nach der Gelatin-Silber-Methode von Fujita, konnte Verf. in den Erythrozyten des Frosches eine dem sog. Apparato reticolare interno von Golgi ähnliche Struktur darstellen, die aus einer lipoid-artigen Substanz besteht, was durch verschiedenen Bedingungen, physikalischen, chemischen und serologischen, positiv bestätigt wurde. Der Verf. glaubt, dass die Ergebnisse dieser Untersuchung im Gebiete der experimentellen Hämatologie eine neue Bahn brechen dürften. S. Nishi.

158. Zytologische Untersuchungen über die Marksubstanz der Nebenniere.
(Japanisch.) J. KAMEDA. [Kaibô. Z., Tôkyô, 8 (1935-36), 1021–1061, 7 Taf.] – (1) Normaler

Befund: Verf. unterscheidet an den Rindenzellen der Nebenniere der Ratte 2 Arten: Helle und dunkle, welche sich erst gleich nach der Geburt unterscheiden lassen. Ihre Funktion beginnt dem Auftreten der Chromreaktion entsprechend erst nach 24 Stunden post partum. Die höchste Funktion der hellen Zellen fällt in den Zeitraum zwischen dem 30. und 40. Tage nach der Geburt; vom 50. Tage an tritt eine Zerringerung der Tätigkeit ein, und ist anzunehmen, dass die Ratte in das ausgewachsene Stadium übergeht. Die dunklen Zellen enthalten in der jungen Form keine gelben Körner. Etwa 90 Tage post partum tritt eine lebhafte Vakuolenbildung ein, die sich aber später verkleinert und jetzt ist das erwachsene Stadium erreicht. Der Sekretionsvorgang geschieht in der Reihenfolge: Plastosomen-Granula-Vakuolen-Sekret. (2) Bei einseitiger Exstirpation: Die hellen Zellen reagieren früher als die dunklen auf die Vergrösserung (Funktionssteigerung), klingen sich aber langsamer als die dunklen ab. Der Verf. konnte nämlich zytologisch feststellen, wie die beiden Zellarten in anderer Weise bei einseitiger Epinephrektomie ihre Funktionssteigerung dartun. (3) Bei der Kastration: - Die beiden Zellarten zeigen eine Funktionssteigerung je nach der Art verschiedenerweise.   S. Nishi.

159. Über die feinere Struktur der Marksubstanz der Nebenniere in der Schwangerschaft. (Japanisch.) J. KAMEDA und K. ARIMITSU. [Kaibô Z., Tôkyô, 8 (1935-36), 1063-69, 2 Taf.] — Das Reaktionsverhalten der hellen und dunklen Markzellen der Nebenniere ist bei den schwangeren Ratten zytologisch untersucht. Im höchsten Stadium der Funktionssteigerung wurde die Existenz beider Zellarten bemerkt; ein Übergang von der hellen zur dunklen oder von der dunklen zur hellen Zelle wurde niemals herausgefunden.   S. Nishi.

160. Beiträge zur morphologischen Entwicklungsgeschichte des Brustschultergürtels und des Brustbeins bei Amphibien. Untersuchungen an den Anuren, besonders bei den Larven von *Rhacophorus schlegelii*. (Japanisch.) Hideo KANEOKA. [Okayama Igk. Z., 47 (1935), 3170-3213.] — Zunächst erscheint der Gliedmassenknospe der Humeruskern, dann die Scapulaanlage, aus der dorsalwärts das Suprascapulare und ventralwärts das Procoracoid und Coracoid sich entwickeln, welch letztere sich bald mit dem Epicoracoid verwachsen. In frühen Entwicklungsstadien zeigt der Schultergürtel die Laxizone, welche sich später in die Firmizonie verwandelt. Das Brustbein, dessen Entwicklung weder mit den Rippen noch mit dem Schultergürtel in Beziehung steht, besteht aus 2 Abschnitten, Prä- und Postzonale, welche aus der Verknorpelung der Zwischensehne zwischen den beiderseitigen Rumpfmuskeln entwickeln.   S. Nishi.

161. Beiträge zur Anatomie des Lymphgefässystems der Wirbeltiere und des Menschen (Japaner). Das Lymphgefässystem des Schimpansen (*Troglodytes niger*). T. KIHARA und G. TESHIMA. [Fol. Anat. Jap., Tôkyô, 13 (1935), 303-324.] — Untersuchung am enthäuteten Material eines jungen Männchen:— 1) Am Hals sind insgesamt links 22 und rechts 14 Lymphdrüsen gezählt. 2) Lymphdrüsen der vorderen Gliedmassen: Je 2 Lgll. cubitales superf. (unter der Fascie) und profundae, 1 Lgl. brachialis, 17 (rechts) bzw. 14 (links) Lgll. axillares und 2 Lgll. suprascapulares (am oberen Rand der rechten Scapula). 3) Lymphdrüsen der hinteren Gliedmassen: 3 (rechts) bzw. 6 (links) Lgll. popliteae superf. und 3 bzw. 1 profundae, je 1 Lgl. tibialis post. und ant., 3 Lgll. inguinales superf. (rechts), (?) Lgll. circumflexae ilei superf., 1 Lgl. circumflexa femoris lat. und 3 Lgll. glutaeae sup. (links). 4) Lymphdrüsen der Bauchwand: 1 Lgl. epigastrica inf. d. umbilicalis. 5) Lymphdrüsen der Bauch- und Beckenhöle: 1 Lgl. iliaca sup. lat., 1 bzw. 2 Lgll. iliacae ing. med., 1 Lgl. iliaca inf. lat. 6) Lymphdrüsen der Brustwand: je 1 Lgl. subpectoralis und sternalis, 4 bzw. 5 Lgll. intercostales und 10 Lgll. praevertebrales. — Die Mündung des Ductus thoracicus befand sich an der hinteren Seite der Vereinigungsstelle der Subclavia und Jugularis interna.   S. Nishi.

162. Über die Entwicklung der Otokonien im Gehörorgan des *Hynobius nebulosus* (Schlegel). K. KIKUCHI. [Fol. Anat. Jap., Tôkyô., 13 (1935), 163-176, 2 Taf.] — Die Otokonien auf der Macula sacculi und der Macula utriculi zeigen bei Larven von 13-14 mm Körperlänge ihr Anfangbild. Sie sind in Frühstadien blasenartig, in späteren krystallförmig. Auf der M. utriculi werden sie dann zylindrisch, auf der M. sacculi sechseckig. Sie bilden auf der M. utriculi, in 4-6 Schichten gehäuft, eine Otokonienplatte, deren Umriss ungefähr dem der M. utriculi ent-

spricht; Auf der M. sacculi bilden sie dagegen eine zusammenhangende Masse. Sie sind in allen Perioden voneinander isoliert und haben je nach den Stadien verschiedene Grösse. Auf der Macula amphibiorum, die am Ductus utriculosacculi liegt, sieht man endlich eine kleine Kalkmasse.

S. Nishi.

163. Über die Furchungserscheinung am Ei des Tritons in Aktionsstrombild.

K. KIKUCHI. [Fol. Anat. Jap., Tôkyô, **13** (1935), 177-182.] — 1) Von der Oberfläche des Tritoneies sind während seiner einzelnen Furchungen mono- und diphasische Aktionsströme ableitbar. (a) Sie beginnen etwas 1 Stunde vor den einzelnen Furchungen und hören etwa 1/2 Stunde vor denselben auf (elektromotorisches Zeichen der Kernteilung). (b) Sie beginnen m t Beginn der einzelnen Furchungen und verschwinden, wenn die Furchenbildung den vegetativen Pol erreicht (elektromotorisches Zeichen der Teilung des Protoplasmas und Dotters). 2) Die Potentialdifferenz bei den einzelnen Furchungen ist grösser als die bei den entsprechenden Kernteilungen; sie wird von Furchung zu Furchung allmählich grösser. 3) Bei den einzelnen Kernteilungen und Furchungen wird der animale Pol elektronegativ gegenüber dem elektropositiven vegetativen. S. Nishi.

164. Zur Struktur und Funktion des Zwischenhirns. III. Kritische Ausführungen über die Kerne in der Pars optica hypothalami des Kaninchens.

K. KITAYAMA und T. NAKASHIMA. [Arb. Med. Fak. Okayama, **4** (1935), 525-536.] — Durch zytoarchitektonische Untersuchung konnten Verff. im Hypothalamus des Kaninchens folgende Kerne unterscheiden:— 1) In der Pars optica hypothalami: Substantia grisea ventriculi tertii, Ncl. mamillo-infundibularis, Ncl. paraventricularis und Ncl. supraopticus (mit Pars dorsolateralis und ventrolateralis). 2) In der Pars tuberalis hypothalami: Ncl. ovalis, Ncl. paraovalis, Ncl. centralis substantiae griseae, Ncl. mamillo-infundibularis und Ncl. tuberis. 3) Pars mamillaris hypothalami: Ncl. corporis mamillaris mit Ggl. anterodorsale (Ncl. periventricularis s. supramamillaris) und Ggl. posteroventrale sowie Ggl. laterale oder Ncl. intercalatus. S. Nishi.

165. Entwicklungsstudien über die Schilddrüsenanlage. II. Untersuchungen an den Anuren, besonders bei den Larven von *Rhacophorus schlegelii.* (Japanisch.)

Hisashi KIYOTANI. [Okayama Igk. Z., **47** (1935), 644-657.] — Die Schilddrüsenanlage entsteht als eine unpaare Zellmasse im ventromedialen Teil der 1. Kiementasche, verlängert sich kaudalwärts und trennt sich dann vollständig von der letzteren ab. Weiterhin wird sie durch die Kopula in beide Lappen geteilt. Die Follikelbildung findet um die Zeit der Metamorphose zuerst im kranialen und kaudalen Teil des Lappens dann im zentralen Teil desselben statt. S. Nishi.

166. Entwicklungsstudien über die Thymusanlage. I. Untersuchungen an den Urodelen, besonders bei den Larven von *Hynobius* aus Okayama. (Japanisch.)

Hisashi KIYOTANI. [Okayama Igk. Z., **47** (1935), 2357 2386.] — Die 4 ersten Thymuspaare entwickeln sich zunächst vom dorsalen Entodermepithel der 1.-4. Kiementasche, das 5. etwas später von dem der 5. Kiementasche, von denen die 1., die 4. und die 5. wieder verschwinden. Die Alterinvolution der persistierenden Thymusdrüsen ist nicht wahrnehmbar. Eine Differenzierung in Mark und Rinde ist bei grösseren Larven über 25 mm erkennbar; die Hassalschen Körperchen treten gleich nach der Metamorphose (29 mm) auf. S. Nishi.

167. Entwicklungsstudien über die postbranchialen Körperchen und die Schilddrüsen bei den Urodelen, besonders *Hynobius* aus Provinz Okayama. (Japanisch.)

Hisashi KIYOTANI. [Okayama Igk. Z., **47** (1935), 2742-2758.] — 1) Die Schilddrüsenanlage zeigt sich als eine solide unpaare Zellwucherung des Schlundkopfepithels am ventromedialen Teil der 1. Kiementasche. Die Abtrennung von der 1. Kiementasche geschieht an der Larve von 9 mm Gesamtlänge, die Teilung in die beiden Lappen an der von 16 mm, die Follikelbildung an der von 20-31 mm. 2) Die postbranchialen Körperchen treten an der Larve von 15 mm Gesamtlänge als eine unpaare solide Zellmasse an der linken Seite der Schlundkopfwand auf und trennt sich bald von dieser ab. Sie bekommen in ihrer Mitte scheinbar ein Lumen, welches aber kein Kolloid enthält. Mit dem Herzbeutel stehen sie auch in keiner Beziehung. S. Nishi.

168. Anatomical and Histological Observations of the Heart of *Tachypleus tri-*

dentatus. (Japanese.) Takeshi KOHCHI. [Okayama Igk. Z., 47 (1935), 992-1012.] — The heart of *T.* is a long tubular organ consisting of one ventricle surrounded by a large pericardial sinus. There are 11 arteries leading off from the heart. The pericardial sinus has 5 pairs of veins or branchiocardiac canals. The cardiac wall is composed of 3 layers of which the innermost consists of circular muscle fibres, resembling those of mammalian heart. The existence of "Vorhof und spezifischen Muskelfasern" (Nukada) could not be recognized. A median cardiac nerve and one pair of lateral cardiac nerves lie longitudinally on the heart making a cardiac plexus. The nerve fibres are without medullary sheath; the median nerve fibres possess ganglion-cells.   S. Nishi.

169. Studien über die Morphogenese der Hirnanlage. II. Über die Vögeln, be-sonders bei den Embryonen von *Hirundo rustica gutteralis.* (Japanisch.) Takeshi KOHCHI. [Okayama Igk. Z., 47 (1935), 2159-2187.] — Verf. fand die Bildung des Neuralrohrs bei einem Embryo mit 11 Ursegmenten, die Abgliederung des Rhombencephalons bei einem mit 14 Urseg-menten, die des Prosencephalons und Mesencephalons bei einem mit 16 Ursegmenten. Bei den Embryonen mit 24-25 Ursegmenten fand die Teilung des Prosencephalons in Telencephalon und Diencephalon statt, und bei Embryonen mit 34-35 Ursegmenten die Teilung des Rhombencephalons in Metencephalon und Myelencephalon, die Bildung der Grosshirnhemisphären und die Teilung des Diencephalons in Parencephalon und Synencephalon statt, dem endlich die Entwicklung des Rhinencephalons folgt. Verf. fand ferner im ganzen 6 Neuromere; aus dem 2. Neuromer entstammte das Ganglion Gasseri und aus dem 4. das Ganglion acusticofaciale.   S. Nishi.

170. On the Development of the Hypophysis of the Anura, Especially of *Rhaco-phorus schlegelii.* (Japanese.) Takeshi KOHCHI. [Okayama Ikg. Z., 47 (1935), 2632-2654.] — The hypophysis of *Rh. schl.* consists of three epithelial lobes and a neural lobe. The Pars anterior develops from the main central portion of the solid epithelial anlage and connects with the infundibulum through the Pars intermedia and the Pars neuralis. The Pars intermedia is derived from the dorso-caudal region of the solid epithelial anlage and the Pars tuberalis from the Pars lateralis which develops from the Pars anterior. The Pars neuralis develops from the caudal tip of the infundibulum and connects with the cranio-dorsal region of the Pars intermedia.   S. Nishi.

171. Studien über die Morphogene des Gehirns bei Kaninchenembryonen. (Japanisch.) Takeshi KOHCHI. (Okayama Igk. Z., 47 (1935), 3286-3323.] — 1) Der Neuroporus anterior schliesst sich früher als der N. posterior. 2) Das Prosencephalon bildet sich bei einem Embryo mit 9 Ursegmenten, das Mesencephalon bei einem mit 11 und das Rhombencephalon bei einem mit 13 Ursegmenten. Die Teilung des Prosencephalons in Tel- und Diencephalon bei einem Embryo mit 32 Ursegmenten und die des Rhombencephalons in Met- und Myelencephalon bei einem mit 46 Segmenten. Die Teilung des Telencephalons in beide Hemisphären bei einem 14 tägigen Embryo mit 46 Segmenten, und die des Siencephalons in Par- und Synencephalon und die Bildung des Rhinencephalons bei einem 16 Tage alten. Ferner sind die Konfiguration einzelner Hirnabschnitte ist eingehend studiert. Was die Neuromerenzahl im Rhombencephalon betrifft, so fand Verf. deren 6. Das Gangl. semilunare wächst vom 2., das Gangl. acusticofaciale vom 4., das Gangl. superius vom 5. und das Gangl. jugulare vom 6. aus.   S. Nishi.

172. Vergleichende Untersuchung über den mikroskopischen Bau der Haut bei der Katze in verschiedenen Körperregionen. Hideo KOMATSU. [Jap. J. Med. Sci., I. Anat., Tôkyô, 5 (1935), 245 253, 7 Taf.] — An der Ohrmuschel, den Augenlidern, dem Nasen-rücken, den Mundlippen, dem Hinterhaupt, Nacken, Hals, Rücken, der Brust, dem Bauch, der Anusgegend, dem Hodensack, Schwanz, an der Streck- und Beugeseite der Vorder und Hinter-extremität, an der Hinter- und Vorderfläche des Mittelfusses sowie an den Zehen- und Sohlen-ballen sind die Dicke der einzelnen Epidermisschichten und des Koriums, das Vorkommen der glatten Muskulatur und der Schweiss- und Talgdrüsen, die Dicke der Hautmuskeln sowie endlich die Zahl der Vater-Pacinischen Körperchen untersucht.   S. Nishi.

173. Beiträge zur vitalen Färbung im Gebiete der Oto-rhino-laryngologie. II.

Bei Säugetieren (Meerschweinchen und Maus). III. Bei Amphibien (Frosch und Kröte). IV. Bei Vögeln (Taube). Yôichirô KURIYAMA. [Juzen. Z., Kanazawa, **40** (1935 , 2730-2736, 3179-3186, 4811-4825.] — Im retikuloendothelialen System der oberen Luftwege, der Mundhöhle und Speiseröhre wird die Farbstoffspeicherung hauptsächlich durch die Histiozyten ausgeübt; in der Gaumentonsille des Meerschweinchens finden sich spärliche Retikulozyten. Auch verhalten sich die elastischen Fasern besonders bei der Maus gegen Trypanblau und Carmin positiv.

<div align="right">S. Nishi.</div>

174. Über die Pigmentwanderung der Pigmentzellen der Froschnetzhaut. III. Über die Wirkung des Hinterlappenho mons der Hypophyse auf die Pigmentwanderung der Netzhautpigmentzellen des Frosches. (Japanisch.) Kiyoshi MATSUO. [Okayama Igk. Z., **47** (1935), 2387-2391, 1 Taf.] — Die subkutane Injektion des Hinterlappenextraktes der Hypophyse an den dunkeladaptierten Frosch bringt die Netzhautpigmentzellen zur Hellstellung, welche aber im allgemeinen stärker ausgeprägt ist als die beim normalen Frosch. S. Nishi.

175. Untersuchungen über die vitale Färbung der Kerne und des Endoplasmas des quergestreiften Muskels. (Japanisch.) Hatasu MATSUNAGA. (Kaibô. Z., Tôkyô, **8** (1935-36), 547 569, 1 Taf.] — Untersuchung des Frosch-Sartorius durch Injektion von Neutralrot und Methylenblau. unter Berücksichtigung der Einflusse der Nervendurchschneidung, der Narkotisierung und einiger chemischen Substanzen. Die vital farbbaren Körner im Endoplasma sind demnach n.chts anderes als die dünne Lipoproteide enthaltenden Vakuolen, welche mit der entartenden Veränderung des Muskels irgend eine bestimmte Beziehung zeigen. S. Nishi.

176. Dunkelfelduntersuchungen an überlebenden Triton-Erythrozyten. I. Vorl. Mitt. Über den Einfluss der H-Ionenkonzentration auf die Triton-Erythrozyten. K. MIYAMOTO, K. YAMADA und S. SHISHIDO. [Fol. Anat. Jap., Tôkyô, **13** (1935), 509 512, 1 Taf.] — Durch Dunkelfelduntersuchungen kann man im Plasma der Triton-Erythrozyten 2 Arten von Granula unterscheiden: 1 2 relativ grosse isolierte, 3-4 gruppierte und zahlreiche feine Granula. Die von Yasuzumi u. a. beschriebenen Stäbchen- und Netzstrukturen (im Plasma der Tritonerythrozyten stehen zur elektrischen Ladung derselben und zur Gelatinisierungswirkung der supravitalen Farbstoffe in Beziehung. S. Nishi.

177. Über die morphologische Entwicklung und die Histologie der Chorda dorsalis der Vögeln. III. Beobachtungen besonders über die Embryonen von *Uroloncha domestica* Flower. (Japanisch.) Bunjirô MIZUNO. [Okayama Igk. Z., **47** (1935), 2331 2356.] — Die Chorda dorsalis entwickelt sich bei *U. d.* gerade sowie bei *Anas domestica* und *Columba domestica* (Vergl. die I. und II. Mitt.). Sie erscheint erst beim Embryo mit 8 Urwirbeln und ihre Entwicklung durchläuft 9 Stadien nacheinander, welche Verf. in der Chorda-Entwicklung bei *Anas* und *Columba* beschrieb. S. Nishi.

178. Experimentelle Studien über die trophische Innervation des Spinalparasympathicus. (Japanisch.) A. NAKAGAWA. [Tôkyô Igk. Z., 49 (1935), 379 408, 2 Taf.] — Verf. konnte bei den Katzen, an welchen die Hinterwurzeln der Lumbosakralsegmente einseitig durchschnitten und die betreffenden Spinalganglien gequetscht wurden, oder die Spinalganglien einseitig exstirpiert wurden, die Geschwürbildung am Fuss und den Zehen der operierten Seite bemerken. Histologisch fand er in loco Degeneration der markhaltigen Nervenfasern, aber keine Veränderung der Gefässe. Ferner bemerkte er dystrophieartigen Veränderungen im Quadriceps femoris der betreffenden Seite. Alles dies soll nach Verf. für die trophische Funktion des sog. Spinalparasympathicus (Kuré) sprechen. S. Nishi:

179. Beiträge zur Entwicklung und Differenzierung des Gewebes der Leber von Kaninchenembryonen, mit Berücksichtigung der die zu vitaler Färbung gebrauchten Farbstoffe phagozytisierenden Fähigkeit des Gewebes. (Japanisch.) Yoshishige NAKAI. [Kaibô. 7., Tôkyô, **8** (1935-36), 941-955, 1 Taf.] — In den verschiedenen Stadien der Schwangerschaft injizierte Verf. mit Erfolg Trypanblaulösung ins Amnionwasser oder in die Bauchhöhle der Kaninchenembryonen, um das fetale Lebergewebe vital zu färben. Die Leberzellen nehmen dabei die injizierten Farbstoffe in verschiedenerweise auf. Bei den Embryonen nach 14 Schwanger-

schaftstagen findet man die Sternzellen und die Fibroblasten, welche den Farbstoff aufnehmen. Gefässendothel, Histiozyten nehmen auch den Farbstoff auf, während die Zellen, welche der Blutzellen und Epithelzellen des Gallenganges differenziert sind, sowie die Riesenzellen (Myelozyten), welche bei den 22 Tage alten Embryonen auftreten, den Farbstoff nicht speichern.

S. Nishi.

180. Beiträge zur Entwicklung und Differenzierung des Gewebes des inneren Ohres von Kaninchenembryonen mit Berucksichtigung der die zur vitalen Färbung gebrauchten Farbstoffe phagozytisierenden Fähigkeit des Gewebes. (Japanisch.) Yoshishige NAKAI. [Kaibô. Z., Tôkyô, 8 (1935-36), 570-600, 2 Taf.] — In verschiedenen Stadien der Schwangerschaft erzielte Verf. guten Erfolg, Trypanblau- oder Karminlösung ins Amnionwasser oder in die Bauchhöhle der Kaninchenembryonen zu injizieren und das Gewebe des inneren Ohres der letzteren vital zu färben. Im einzelnen sie auf das deutsche Autorreferat angewiesen. Verf. empfielt dabei Trypanblau für die vitale Färbung der Embryonen wegen seiner schwachen Giftigkeit und starker Differenzierbarkeit als das zweckmässigste.

S. Nishi.

181. Über die Entwicklung des Vornierenkanälchensystems der japanischen Kröte (*Bufo formosus*). Yoshiharu MATSUKURA. [Fol. Anat. Jap., Tôkyô, 13 (1935), 417-448.] — Die Vorniere von *B. f.* zerfällt in 2 verschiedene Teile: den „ Nephrostomalteil " und das „ eigentliche Kanälchensystem ". Der erstere, 3 in Zahl, entsteht aus einer Ausstülpung der Somatopleura und scheidet sich später in das Nephrostom und das Nephrostomalkanälchen. Das eigentliche Kanälchensystem entsteht aus dem 1. und 3. Ursegment abgeschnürten Nephrostomen. Aus dem 1. Nephrostom bildet sich das 1. Vornierenkanälchen, aus dem 2. der Sammelgang und die kraniale Hälfte des Verbindungsstückes und aus dem 3. das 3. Vornierenkanälchen und die kaudale Hälfte des Verbindungsstückes. Auch differenziert sich Vornierengang segmentär aus den Ursegmenten und bildet die kaudale Fortsetzung des medialen Randes der Vorniere. Die Degeneration schreitet von dem Endabschnitt des Kanälchensystems aus rückläufig zum Vornierenkanälchen fort. Nur bei dem Nephrostomalkanälchen geht sie unabhängig früher vonstatten.

S. Nishi.

182. Embryologische Studien über den sogenannten äusseren Glomerulus der Vorniere bei der japanischen Kröte (*Bufo formosus*). (Japanisch.) Yoshiharu MATSUKURA [Kaibô Z., Tôkyô, 8 (1935-36), 723-737] — Der Glomerulus der Kröte erreichte bereits bei 5.3 6.0 mm langen Kaulquappen seine maximale Entfaltung, um sich bald danach rasch zurückzubilden und schliesslich mit dem Fortschreiten der Metamorphose allmählich zu verschwinden. Die kleinen Ausfaltungen des inneren Blattes der lateralen Platte verschmelzen in 4 hintereinander liegende Glomerulussegmente, von denen das erste nur ein Paar von Zu- und Abflussgefäss enthält und am frühesten zurückgeht, während die 3 kaudalen je 2 Paare davon enthalten und sich stärker entwickeln. Das Vas afferens steht mit der Aorta, und das Vas efferens mit der V. cardinalis in Kommunikation. Die Vornierenkammer, welche stets einheitlich und vom Coelom scharf abgegrenzt ist, verwischt sich mit der Ruckbildung der Vorniere ganz vom Coelom. S. Nishi.

183. Zytologische Studien über das Ependym. I. Über die Gehirnventrikel (speziell den Zwischenhirn und Mittelhirnventrikel) bei den Reptilien und Amphibien. (Japanisch.) Shunshirô MATSUMOTO. [Kaibô Z., Tôkyô, 8 (1935-36), 956-971.] — Material: *Amyda japonica, Clemys japonica, Elaphe quadrivirgata, Tachydromus tachydromoides, Rana mugiens* und *Bufo vulgaris.* Untersuchung durch Wachsmodellrekonstruktion. Die Ependymzellen der Ventrikelwand zeichnen sich bei allen untersuchten Tieren von allen übrigen Ependymzellen durch ihre ungewöhnliche Höhe, sodass ihre Funktion wahrscheinlich auch eine andere sein muss als die aller sonstigen Ependympartien.

S. Nishi.

184. Über den Bau und die jahreszyklischen Veränderungen der Brunstschwiele bei den japanischen Kröte (*Bufo formosus*). (Japanisch.) Minoru NAKASHIMA. [Kaibô. Z., Tôkyô, 8 (1935-36), 1177-1209.] — Die Brunstschwiele kommt bei *B. f.* am 1.-4. Finger konstant vor und besteht aus vielen „ Schwielenkegelchen" mit zahlreichen „ Schwielenhäckchen". An der Epidermis lassen sich zwei Zellschichten unterscheiden: die hypertrophierte Epidermisschicht und die spezifische Hornschicht. Die Brunstschwiele zeigt am Ende März oder am Anfang April

die höchste Entfaltung und im Frühsommer die schwächste Entwicklung. Die Regeneration beginnt im Spätsommer und geht während des Winterschlafes lebhaft vor sich. S. Nishi.

185. Histologische Studien über die Antiserumwirkung. 1. Über Umformungen der Zellen des Bindegewebes bei Zusatz des Antiserums in vitro. T. NISHIMURA. [Fol. Anat. Jap., Tôkyô, 13 (1935), 449-464, 2 Taf.] — Material: Subkutanes Bindegewebe der weissen Ratte und des Kaninchens. Kulturmedium: Locke-Dextroselösung. 1) Bei einstündiger Kultivierung sieht man eine Kontraktion aller Zellelemente und eine Umgestaltung des Zellkerns, manchmal sogar ein Neuentstehen von monozytären Rundzellen und eine amitotische Kernteilung. 2) Die Veränderungen treten nach 2 Stunden etwas stärker auf, wobei die Fibrozyten den Histiozyten ähnlich sehen und die monozytären Rundzellen an Zahl zunehmen. 3) Mit der Zeit werden die Veränderungen immer stärker; die meisten Zellen ziehen sich bis zu monozytären Rundzellen zusammen. 4) Die Veränderungen kommen am stärksten in dem das Antiserum enthaltenden, etwas schwächer in dem das Normalserum enthaltenden Medium und endlich am schwächsten in der Locke-Dextroselösung zu Vorschein. 5) Sofern sich das Serum in der Konzentration von 0.5 bis 10% findet, wirkt es desto giftiger, je höher seine Konzentration steht. 6) Im verdünnten Antiserum nimmt das Gewebe gar nicht an Umfang zu, vielmehr zieht es sich deutlich zusammen, wenn die Konzentration des Serums über 2% hinaus steht. S. Nishi.

186. Studien über die Entwicklung der Nierenanlage, besonders über die morphologischen Verhältnisse bei Kaninchenembryonen. (Japanisch.) Toshiharu OHFUJI. [Okayama Igk. Z., 47 (1935), 916-6 0.] — Die Nierenknospe bildet sich zuerst an der Endstelle des Urnierenganges aus, verlängert sich allmählich und teilt sich in das primäre Nierenbecken und den Ureter ein. Der Ureter mündet kaudalwärts zuerst an der Endstelle des Urnierenganges, später in die Kloake aus. Vom Nierenbecken entspringen primäre Sammelröhre, welche weiter sekundäre bis quintäre Sammelrohre produzieren, um mit den Harnkanälchen zu kommunizieren. Das metanephrogene Gewebe bildet sich von der kaudalen Partie des nephrogenen aus und lässt sich in 2 Zonen teilen: dichte Innenzone und lockere Aussenzone. Die erstere umgibt das Nierenbecken und ihr bilden sich die Harnkanälchen. Die Hohendifferenz zwischen beiderseitigen Nieren ist erst beim 13 mm langen Embryo bemerkbar, bei welchen die rechte Niere etwas 60 μ höher steht als die linke. S. Nishi.

187. Über die Entwicklung der Harnblase bei den Kaninchenembryonen. (Japanisch) Toshiharu OHFUJI. [Okayama Igk. Z.. 47 (1935), 3406-3438.] — Über die Entwicklung der Harnblase kam Verf. durch Untersuchung am Kaninchen gegen Keibel u. a. zu folgenden Schlüssen:— Die erste Harnblasenanlage entwickelt sich in einer dem Nabel naheliegenden Partie des Urachus (Urachussäckchen d. Autors); ein dem Trigonum entsprechende Teil der Blasenbasis dagegen vom Allantoisschenkel Die Uretermündungen, welche anfangs nahe den Wolffschen Gängen liegen, dringen kranialwärts vor und gehen endlich in die Blasenbasis über, was durch bedeutende Ausdehnung des Allantoisschenkels zwischen der Uretermündung und der Mündung des Wolffschen Ganges bedingt wird, und durch diese Ausdehnung des Allantoisschenkels entsteht die primäre Harnrohre. S. Nishi.

188. Über die braune Inguinaldrüse des Kaninchens. (Japanisch.) Keiichi OKADA und Akira UEDA. [Kaibô. Z., Tôkyô, 8 (1935 36), 605 6 2. 2 Taf.]- Verf. studierte makro- sowie mikroskopisch die sog. braune Inguinaldrüse in der sog. Inguinaltasche (R. Krause) des Kaninchens. Sie ist eine zusammengesetzte verzweigte tubuloalveolare Drüse; während der Entwicklung verändern sich die Epithelien der intra- und interlobulären Ausführungsgänge in einem bestimmten Bezirke in die Drüsenepithelien. Sie ist apokrin und als eine Art der Duftdrüse aufzufassen. S. Nishi.

189. Histo-pathological Studies of the Pituitary Body, Especially of the Anterior Lobe. (Japanese.) Ryôzô OKAMOTO. [Keiô Ig., Tôkyô, 15, (1935), 183-324, 6 pl.] — In the paper the anatomical and histological observations of the pituitary body in normal conditions are also made. Average weight and size of 121 cases of adults between 21 and 60 years of age:—

	♂	♀	♂ + ♀
Average weight	0.605 g	0.641 g	0.62 g
Average size	1.36 × 0.97 × 0.63	1.38 × 0.99 × 0.65	1.37 × 0.97 × 0.65 cm

the weight and size of the gland increase rapidly at puberty, gradually reaching the maximum in male between 40 and 45 and in female between 35 and 45 years of age. The g'and of female after puberty is heavier and larger than that of male throughout the later life, especially in pregnancy. The pregnant cells appear in the 3rd month of pregnancy and increase gradually their number at the later stages becoming about equal to that of eosinophilic cells in the 7th and 8th month. This change is more marked in multiparous cases. Regression of the pregnant cells begins at about the 2nd week of parturition, but they remain throughout the life, so that their presence is clear indication of past pregnancy. They contain acidophilic inclosures which are specific to pregnancy. A salivary glandular body found adjacent to the posterior lobe has similar structure as the serous gland in mouth and is found in 91% of the cases. Its excretory duct is communicated with the Rathke's sack. Ciliary epithelium is found in the medullary part, which may be regarded as extension of epithelium of the Rathke's sack. On the sides of attachment of the gland a group of flat epithelial cells is often found (46%, they may have been detached in developmental stage from the duct of pituitary gland by some reason. Round cell masses found in the medullary part are lymphatic.   S. Nishi.

190. Zur Entwicklung der Plexus chorioidei bei den Amphibien. I. Studium bei unseren einheimischen Kröten. (Japanisch.) Shôji OMOCHI. [Kaibô. Z., Tôkyô, 8 (1935-36), 849–868.] — 1) Die ersten Anlagen der Pl. ch. der beiden Hirnventrikel treten schon in dem Stadium auf, in dem die Kaulquappe aus den Gallertmasse austreten. Die Gefässe der Pl. ch. entwickeln sich noch früher. Das Epithel der Plexusanlage ist im Frühstadium etwas reichlicher am Pigment als das übrige Epithel. Das Pigment verschwindet später mit Ausnahme der Spitzenteile, wo die Pl. auch im adulten Zustande eine gewisse Menge von Pigment enthalten. 2) Der Pl. chorioides ventriculi III. wird im ausgebildeten Zustande in 3 Abteilungen geteilt; der Pl. ch lateralis und der Pl. ch. inferior sind stärker und etwas früher entwickelt als der Pl ch. medius. Die beiden ersteren werden präparahyseale, der letztere postparaphyseale Abteilung des Pl. ch. genannt. 3) Der Pl. ch. ventriculi quarti wird auch in 3 Hauptabteilungen geteilt: die zentrale und laterale Abteilung sowie die Seitenäste.   S. Nishi.

191. Über die Entwicklung des Corpus luteums beim Kaninchen. (Japanisch.) Etsuji SANO. [Juzenkwai Z., 40 (1935), 595–604.] — Die Luteinzellen entwickeln sich von Theca-interna-Zellen, nicht aber von Granulosa-Zellen, welche mit der Ovulation grösstenteils herausgestossen werden. 72 Stunden nach der Begattung sieht man schon das C. l. in vollkommenem Zustand. Es nimmt bis zum 10. Tage allmählich an Grösse zu, bleibt etwa 5 Tage lang stationär, um demnach sich allmählich wieder zurückzubilden.   S. Nishi.

192. Studien über die Morphologie und Histologie der Anurenhypophyse. III. (Japanisch.) Kan SATOH. [Okayama Igk. Z., 47 (1935), 1-23.] — Material: *Bufo vulgaris japonicus, Rana temporaria ornativentris, Polypedates huergeri* Boulenger Der Hauptlappen ist von vielen Follikeln zusammengesetzt, welche aus zahlreichen eosinophilen, weniger zahlreichen basophilen und nur sparlichen chromophoben Zellen bestehen. Im Zwischenlappen findet sich mit Ausnahme von *Rana* kein Gefässe und verschieden grosse Kolloidmassen sind intra- und interzellular reichlich vorhanden. Der Hirnlappen besteht aus geringen Zellen und reichlichem Stützgewebe. Von zahlreichen Gefässen einige erweitern sich bei *Bufo* sinusartig. Die paarige Pars tuberalis, welche keinen histologischen Zusammenhang mit dem Hauptlappen aufweist, besitzen reichliche Menge von runden und ovalen Zellkernen, ähnlich wie der benachbarte Zwischenhirnteil.   S. Nishi.

193. Studies in the Mitochondria, Metachondria, on Golgi's Apparatus and on the Silver Granules of Lieberkuhn's Gland Cells of the Intestine of the White Rat. Yeizaburô SAWADA. [Jap. J. Exp. Med., Tôkyô, 13 (1935), 441–455, 1 pl.] — Following studies were made on the white rat:— 1) Findings in the mitochondria and metachondria (Mitamura) of the Lieberkühn's gland cells under the stimulus of food and at the time of starvation. 2) Influence of the cell constituents of the middle portion of the small intestine inoculated parentally on

the mitochondria and metachondria of the same intestinal portion. 3) Influence of various drugs (histamin, pilocarpin, atropin, cholin, adrenalin, insulin) on the mitochondria and metachondria of the Lieberkühn's gland cells. The Golgi's apparatus and the silver granules in the Lieberkühn's gland cells of the middle portion of the small intestine are also studied.   S. Nishi.

194. Über die Entwicklung des Hyobranchialskeletts der Amphibien. 2. Untersuchungen bei *Rhacophorus schlegelii*. (Japanisch.) Takeo SHIMOYAMA. [Okayama Igk. Z., 47 (1935), 2452.]

— Die beiderseitigen Hyalia verbinden sich frühzeitig; der Verbindungsteil wandelt sich später als Pars reunions zu eigenartigem Knorpelgewebe. Alle 4 Branchialia treten sehr frühzeitig auf; die Hypobranchialplatte wird aber nur aus den Elementen des Branchiale 1. gebildet. Das vollentwickelte Zungenbein besteht nur aus den Elementen des Hyale und des Branchiale I. sowie aus dem parakopularen Streifen, einem Abkömmling der Kopula. Der Processus thyreoideus ist ein Rest der Hypobranchialplatte.   S. Nishi.

195. Über die Entwicklung des Hyobranchialskeletts der Amphibien. 3. Untersuchung bei *Diemyctylus pyrrhogaster*. (Japanisch.) Takeo SHIMOYAMA. [Okayama Igk. Z., 47 (1935), 3258–3285.]

— Das Hyale entwickelt sich ganz isoliert von der Kopula, mit der es später zusammenfliesst, um in weiterer Entwicklung sich wieder von ihr abzutrennen. Das Hypohyale gliedert sich vom Keratohyale ab, verschwindet sich aber spullos in der Zeit der Metamorphose. 2) Das Branchiale 1. entwickelt sich unabhängig von der Kopula, verbindet sich aber bald mit ihr, um sich am Anfang der Metamorphose wieder von ihr abzutrennen. 3) Das Branchiale 2. verbindet sich auch mit seinem Hypobranchialteil mit dem Basibranchiale der Kopula, um wieder sich bald von dem letzteren loszulösen. Das Keratobranchiale 2. verschwindet sich am Ende der Metamorphose. 4) Das Hypobranchials 3. tritt niemals auf; das Keratobranchiale 3. und 4. verschwinden am Ende der Metamorphose, während das Keratobranchiale 2. erhalten bleibt. 5) Das Basibranchiale 1. tritt als Anlage der Kopula auf, verbindet sich bald mit dem Basibranchiale 2. 6) Am Anfang der Metamorphose entsteht der sog. Bügelknorpel paarig aus der dorsalen Knorpelmembran des Basibranchiale 1. 7) Das Urobranchiale entwickelt sich in früher Periode vom Basibranchiale 1, wird während der Metamorphose von seinem Kopfteil resorbiert. 8) Im vollentwickelten Stadium findet am ganzen Hyobranchialskelett eine Verknöcherung statt, nämlich am Keratohyal, Hypo- und Keratobranchiale 1, Hypobranchiale 2, der Kopula und dem Bügelknorpel.   S. Nishi.

196. Beiträge zur Kenntnis über die Entstehung der sog. Cartilago Santorini am kranialen Rande des Arytänoid von Anuren. (Japanisch.) Takeo SHIMOYAMA. [Okayama Igk. Z., 47 (1935), 658–672.]

— Das später sich zur C. S. entwickelnde Element tritt bei *Rhacophorus schlegelii* zuerst am ventralen Rande der Prominentia apicalis dorsalis als Gewebswucherung auf, welche die Inzisur vollständig erfüllt, aber später entsteht hier ein isoliertes Knorpelchen durch Reduktionsvorgang an der Grenze zwischen ihr und der Inzisur.   S. Nishi.

197. Studies on Mitochondria and Metachondria of the Gland Cells of the Pancreas. Ichirô SUZUKI. [Jap. J. Exp. Med., Tôkyô. 13 (1935), 285–307, 1 pl]

— Following studies are made on guinea-pig:— 1) Changes in the mitochondria and metachondria of the pancreas gland cells caused by taking food and by starvation. 2) Influence of various drugs (histamin, pilocarpin, choline, glycocoll, sodium glutaminate, adrenalin, insulin), on the pancreatic gland cells. 3) Influence of the pancreatic gland cell constituents injected per enteron on mitochondria and metachondria of pancreatic gland cells. 4) Influence of the extracted substance of pancreatic gland cells inoculated per enteron on mitochondria and metachondria of pancreatic gland cells.   S. Nishi.

198. On the Commissura transversa Halleri in Cyprinoids. N. SUZUKI. [Fol. Anat. Jap., 13 (1935), 13–44.]

— The brains of the adult specimens of *Cyprinus carpio*, *Carassius carassius* and *C. auratus* were employed and following fibers and nuclei were precisely detected:— 1) Fibers which are united with the Commissura transversa, or which have their own endings or origins in the Torus semicircularis. 2) Fibers, which have only a spacial relation with the

C. tr. 3) Fibers which for a short distance connect with or simply pass through the C. tr. 4) Fibers in the fibrillar paratransversal area. 5) Nuclei which have the direct relation with the components of the C. tr. or its collaterals. 6) Nuclei which have a spacial relation with the C. tr. in its origin or termination. S. Nishi.

199. Über die Deckknochen des Unterkiefers vom _Pseudosalamander naevia_ Schlegel. (Japanisch.) Tôju SUZUKI. [Kaibô. Z., 8 (1935-36). 520-523.]— Die Larven von _P. naevia_ besitzen am Unterkiefer wie die von _Megalobatrachus, Onychodactylus_ und _Hynobius_ 4 folgende Deckknochen: Dentale, Coronoideum, Goniale und Angulare. S. Nishi.

200. Über die Entwicklung der Magendrüsen bei den Vögeln. Untersuchung an Zwerghuhn (_Gallus domesticus_ Linné). (Japanisch.) Teido TAKAI. [Okayama Igk. Z., 47 (1935), 128-144.] — Die Magendrüsen des Zwerghuhns entstehen durch Einstülpung des Vormagen-epithels in das Mesoderm und in die Muskelschicht. Sie lassen sich zunächst in Hals- und Grundteil, in weiterer Entwicklung in Hals-, Körper- und Grundteil unterscheiden. Ihre Entwicklung beginnt zuerst in der Umgebung des mittleren Teils des Vormagens, und schreitet allmählich sowohl kopf- als auch schwanzwärts hin. S. Nishi.

201. Über die Wirkungen des Jodes und der Schilddrüsenpräparate auf die Submaxillardrüse bei Kaninchen. (Japanisch.) Iwao TAKEMOTO. [Okayama Igk. Z., 47 (1935), 2216-2221, 2 Taf.] — 1) Nach der Injektion kleiner Menge von Jodlösung werden die Drüsen-zellen immer schwächer färbbar, sodass man endlich die hellen und dunklen Zellen kaum unter-scheiden kann; der Golgische Apparat wird länger und dünner. Nach der Injektion grösserer Menge des Medikamentes werden die Drüsenzellen zerstört. Das Jod beteiligt sich also nicht an den Sekretionsvorgängen und scheint schon in 3 Stunden durch die Drüse ausgeschieden zu werden. 2) Wenn man dem Kaninchen das Schilddrüsenpräparat, Thyreoprotein injiziert, so vermehren sich einstweilen die groben Körner in den dunklen Zellen, welche nach 24 Stunden fast gänzlich verschwinden, um sich erst danach nochmals zu vermehren. Der Golgische Apparat entwickelt sich anfangs gut, geht aber bald zurück, um endlich zu einfachem Klümpchen zu werden. Das Netzwerk der hellen Zellen wird etwas grösser, der Golgische Apparat wird in Staub zerstört, um danach sich wieder zu herstellen. Diese Veränderungen werden dadurch erklärt, dass die Schilddrüsenhormone die Drüsenzellen reizen und die Sekretionsvorgänge befördern. S. Nishi.

202. Über den Fadenkern Molisch am tierischen Gewebe. Oto TAMURA. [Arb. med. Fakultät, Okayama, 4 (1935), 365-369.] — Verfasser fand bei der Untersuchung der Säugetierherzen zufällig die sog. Fadenkerne Molisch und zwar in 4 Fällen, nämlich in Herzen eines erwachsenen Rindes, zweier erwachsener Schweine und eines 57 jährigen Mannes. Sie lokalisieren am Schweine im Endokard des rechten Vorhofs über der medialen Tricuspidalis, sowie der linken Ventrikelscheidewand, am Rinde ausserdem in einem falschen Sehnenfaden, und am Menschen im Sulcus coronarius des linken Herzens, also bei allen Fällen an den Zonen, die wo nach der Ansicht des Verfassers Herzmuskulatur fortwährend neu entwickelt. S. Nishi.

203. Über eigenartige Riesensternzellen von Urodelen mit nur supravital färbbaren Granulis. Oto TAMURA. [Fol. Anat. Jap., Tôkyô, 13, (1935), 574-576.] — Im Peritonealgewebe von Urodelen (_Triton_) hat Verfasser eigenartige den Mastzellen ähnliche aber in vielen Punkten von diesen abweichende Zellen gefunden, welche entweder frisch oder durch supravitale Färbung (Methylenblau, Neutralrot, Nilblausulfat usw.) darstellbar sind, aber bei Hinzufügung einiger Tropfen irgend eines Fixationsmittels plötzlich den Augen der Beobachtenden entschwinden. Sie sind bisher sonst bei Anuren, Reptilien, Vögeln und Säugetieren nicht gefunden. S. Nishi,

204. Beiträge zur Anatomie des Lymphgefässystems der Wirbeltiere und des Menschen. Das Lymphgefässystem des Macacus (_M. rhesus_). G. TESHIMA. [Fol. Anat. Jap., Tôkyô, 13 (1935), 251-288.] — An 37 Exemplaren von _M. rh._ ist das Lymphgefässystem des ganzen Körpers nach der Methode Gerotas eingehend studiert. Folgende Lymphdrüsen sind

angegeben:— 1) Am Kopf und Hals: Lgl. buccinatoria (1), Lgll. parotideae (2-7), Lgll. submaxillares (3-4, manchmal 8-12), Lgl. cervicalis superf. (1), Lgll. cervicales prof. sup. mit medialer und lateraler Gruppe (6-10) und Lgll. cervicales prof. inf. (1-3). 2) An der vorderen Extremität:— Lgll. axillares ing. (3-8) und inf. (1-2). 3) An der hinteren Extremität:— Lgl. poplitea (1) Lgll. inguinales superf. (3-9). 4) An den äusseren Genitalen:— Lgll. pubicae, an den beiden Seiten der Schamfuge auf dem Ursprung des Adductor magnus (1-2). 5) In den Bauch- und Beckenhöhle:— Lgll. iliacae distales (1-4) und proximales (1-4), Lgll. hypogastricae (1-2), Lgll. sacrales (1 2), Lgll. aorticae caudales und craniales (gewöhnlich je 1 jederseits), Lgll. phrenicae (je 1 jederseits), (f) Lgll. mesocolicae (40-63), Lgll. iliocoecales (5-7), Lgll. mesentericae (7-9), Lgll. pancreaticolienales (4-6), Lgll. gastricae (1-4), (k) Lgll. pancreaticoduodenales (2-5) und Lgll. hepaticae (gewöhnlich 2). 6) In der Brusthöhle:— Lgll. sternales (fehlen manchmal), Lgll. intercostales (2-7, fehlen in kranialen Interkostalräumen.) und Lgll. bronchiales: Lgll. tracheobronchiales (2-4), Lgll. bifurcationis. Ferner sind die Hauptsammelröhre der Lymphe untersucht und den Ductus thoracicus bei einem Fall unter 11 Fallen in der rechten Seite gefunden.   S. Nishi.

205. Beiträge zur Anatomie des Lymphgefässystems der Wirbeltiere und des Menschen (Japaner). Das Lymphgefässystem des Lemurs (*Lemura macacus*). G. TESHIMA. [Fol. Anat. Jap., Tôkyô, **13** (1935), 289–301.] — Untersuchung an einem Exemplar von *L. m.* folgende Lymphdrüsen sind angegeben:— 1) Am Kopf und Hals: Lgl. submaxillaris (1), Lgll. parotideae (rechts 3), Lgl. cervicalis profunda cranialis (1) und Lgll. cervicales profundae caudales (rechts 1, links 3). 2) An der vorderen Extremität: Lgl. axillaris (1). 3) An der hinteren Extremität: Lgl. poplitea (1), und Lgl. inguinalis (jederseits 1). 4) In der Bauch- und Becken- höhle:— Lgll. iliacae (rechts 4, links 2), Lgll. aorticae (6), Lgll. mesentericae et mesocolicae (5 am Stamm der A. mesenterica, 3 am Dickdarma,t derselben) und Lgl. pancreaticolienalis (1). 5) In Brusthöhle: Lgll. paratracheales (3), Lgll. tracheobronchiales (jederseits 1), Lgl. bifurcationis (1), Lgl. cordis (1) und Lgl. sternalis (1), — Der Ductus thoracicus mündet in die Vene an der hinteren Seite des Vereinigungswinkels der linken Subclavia und Jugularis externa ein.
S. Nishi.

206. Über die Morphogenese der Hypophysis cerebri bei den Vögeln. II. Unter- suchung bei *Uroloncha domestica* Flower. (Japanisch.) Takeshi WATANABE. [Okayama Igk. Z., **47** (1935), 611–628.] — 1) Die erste Hypophysenanlage tritt am Embryo mit 12 Urseg- menten als eine Epitheleinbuchtung im Winkel zwischen dem Munddach und der Rachenmem- bran auf. 2) Zwischen der Seesselschen Tasche und der Hypophysenanlage ist eine mächtige Mesenchymfalte ausgebildet. 3) Die paarige Pars tuberalis wächst seitlich an der Wurzel der Rathkeschen Tasche als knospenförmiger Fortsatz, welcher von Anfang an kein Lumen in sich einschliesst.   S. Nishi.

207. Über die Morphogenese der Meibomschen Drüsen beim Kaninchen. (Japanisch.) Takeshi WATANABE. [Okayama Igk. Z., **47** (1935), 2689–2699.] — Die erste Anlage der M. schen Drüsen tritt als knospenartige Einstülpungen des Stratum cylindricum ins mesenchymale Gewebe (Stadium des Epithelhöckers). Die Epithelhöcker entwickeln sich dann in einem lang- gestreckten Zapfen, welche sich in der Mitte verdicken, so dass sie eine Spindelform annehmen. Die Sprossung der Drüsenläppchen beginnt in der Nähe der Drüsenmündung und schreitet nach seinem Ende fort. Die Aushöhlung des Zentralganges geschieht endlich durch Verfettung der Drüsenzellen, an die dann die Trennung der Lidränder anschliesst, welche erst bei den Jungen 11 Tage nach der Geburt stattfindet.   S. Nishi.

208. Zytologische Studien über die chromaffinen Zellen in der Schleimhaut des Duodenums. (Japanisch.) Masaichi YAMADA. [Kaibô Z., **8** (1935-36.) 113-136, 3 Taf.] — Material: Affe, Rind, Schwein, Pferd, Hund, Katze, Kaninchen, Meerschweinchen, Maus, Ratte und Huhn. Methode: Heidenhain, Benda und Altmann. Die Zellen liegen am Fundus oder an der Seitenwand der Darmkrypten und enthalten in ihrem Basalteil Granula, welche azydophil, siderophil und chromaffin sind. Von ihrer vielfach besprochenen Lokomotion ist keine Rede. Die sog. hellen Zellen sind nichts anderes als dieselben Zellen in mit Sekret ausgefülltem

Zustand. Das Sekret wird basalwärts ausgeschieden, sodass die Zellen eine Art innerer Sekretion zu machen scheinen. S. Nishi.

209. Über die Tanzmaus. I. Vergleichend-anatomische Untersuchung des statischen Organs des Ohrlabyrinthes bei der Tanzmaus und bei der gewöhnlichen Maus. (Japanisch.) Isao YASUHARA. [Okayama Igk. Z., **47** (1935), 2527-2548, 3 Taf.] — Untersuchung durch Plattenmodellrekonstruktion:— Zwischen der Tanzmaus und der gewöhnlichen Maus zeigen die Bogengänge keinen nennenswerten Unterschied; jeder Bogengang und jede Ampulla ist bei beiden ebenso gut entwickelt. Nur das Ganglion vestibulare zeigt bei der Tanzmaus gewisse Veränderungen; die Ganglienzellen sind vergrössert, die Nisslschen Körperchen undeutlich oder verschwunden, der Kern auch undeutlich oder verschoben. Die eigentümliche Kreisbewegung der Tanzmaus mag demnach auf eine Entwicklungsstörung des N. vestibularis zurückzuführen sein. S. Nishi.

210. Über die Tanzmaus. II. Vergleichend-anatomische Untersuchung der Gehörorgane bei der Tanzmaus und bei der gewöhnlichen Maus. (Japanisch.) Isawo YASUHARA. [Okayama Igk. Z., **47** (1935), 2717-2725, 2 Taf.] — Die Tanzmaus ist gegen verschiedene Schallreiz reaktionslos; sie ist also taub. Histologisch zeigt das Cortische Organ keine Besonderheiten. An den Zellen des Ganglion spirale sieht man dagegen eine primäre Entartung, welche in der Basalwindung der Schnecke am auffallendsten hervortritt. S. Nishi.

211. Über die Tanzmaus. III. Vergleichend-histologische Untersuchung des Ohrlabyrinthes der Tanzmaus und dessen der gewöhnlichen Maus. (Japanisch.) Isawo YASUHARA. [Okayama Igk. Z., **47** (1935), 2726-2741.] — Verfasser konstatierte bei der Tanzmaus eine degenerative Veränderung in den Ganglienzellen im Vorhof und im spiralen Ganglion, worauf Verf. das eigentümliche Benehmen und die Taubheit der Tanzmaus zurückführen will. Sonst konnte er keine histologische Veränderung im Acusticus sowie in der Hörsphäre der Grosshirnrinde feststellen. S. Nishi.

212. Über den isoelektrischen Punkt der tierischen Gewebe. 3. Über den isoelektrischen Punkt des quergestreiften Muskels. G. YASUZUMI. [Fol. Anat. Jap. **13** (1935), 55-61.] — Der isoelektrische Punkt des M. sartorius von *Rana fusca* wurde unter Berücksichtigung verschiedener Zustände, wie der Ernährung, der Ermüdung u. a., durch Färbungsverfahren bestimmt. S. Nishi.

213. Über den isoelektrischen Punkt der tierischen Gewebe. 4. Über den Einfluss von Fixierungsmitteln auf die Färbbarkeit der Erythrozyten. G. YASUZUMI. [Fol. Anat. Jap., Tôkyô **13** (1935), 333-342.] — Der pH wert von etwa 17 gebräuchlichen Fixierungsmitteln wurden mit Folien-Kolorimeter bestimmt und der Einfluss der Fixierungsmittel auf den isoelektrischen Punkt der Erythrozyten beobachtet:— 1) Der isoelektirische Punkt der E. lässt sich durch Aufbewahrung in isotonischen Kochsalzlösungen von verschiedener H-ionenkonzentration verschieben. 2) Die Veränderung der elektrischen Ladung der E. erfolgt nicht immer nur durch die innige Beziehung mit der H-ionenkonzentration sowie der Hämoglobin- und Stromasubstanzfällungsfähigkeit der Fixierungsmittel. 3) Kaliumbichromat, Sublimat, Chromsäure und Trichloressigsäure verschieben den isoelektrischen Punkt der E. nach der alkalischen Seite, Pikrinsäure, Platinchlorid und Osmiumsäure dagegen nach der sauren Seite. 4) Solche Fixierungsmittel wie Müller und Zenker nach der alkalischen und solche wie Helly, Orht, Rabl, Champy, Benda, Meves. Maximow und Altmann dagegen nach der sauren Seite. S. Nishi.

214. Über den isoelektrischen Punkt der tierischen Gewebe. 5. Über den isoelektrischen Punkt einiger Zellen unter verschiedener Versuchsbedingung. G. YASUZUMI. [Fol. Anat. Jap., **13** (1935), 465-472.] — Material: Epithelzellen verschiedener Organe des Maus- und Kaninchenembryos. 1) Auf Grund der Fixierungstechnik mit absolutem Alkohol und mit darauf folgender Toluidinblau- und Ponceaufärbung wurde es augenscheinlich, dass der IEP des Plasmas und häufig auch der des Kernchromatins sich mit der Abnahme der Zelltätigkeit nach der alkalischen Seite und mit dem Eintritt erhöhter Lebenstätigkeit nach der sauren Seite

verschiebt. 2) Der IEP des Plasmas ist topographisch verschieden, was an den Pankreaszellen nachweisbar ist. 3) Die Verschiebung des IEP ist artspezifisch, d. h. manche Zelle wird von der Alters- und Ernährungsverschiedenheit und dem verschiedenen Funktionszustande in ihrem Ladungsverhältnis empfindlich beeinflusst, während andere fast unbeeinflusst bleibt.

S. Nishi.

215. Über das Corpus geniculatum mediale vom Typus des gewundenen Graus beim Gibbon. Gennosuke FUSE. [Arb. Anat. Inst. Sendai, **17** (1935), 195-201.] — Beim weisshändigen Gibbon (*Hylobates lar* L.) zeichnet sich das Corpus geniculatum mediale durch die Anordnung der Nervenzellen zu langen, vielfach gewundenen und zusammengeballten Bändern. Die Faltenkonglomeratbildung dieses Kerns ist in der Säugerwelt bisher von niemand angegeben worden. Nach eingehender Beschreibung über den in Frage stehenden Kern weist Verf. auf das interessante Faktum hin, dass bei diesem Gibbon die zentralen akustischen Bahnen zwei Endstätten vom Typus des Faltengraus, nämlich die obere Olive und den medialen Kniehöcker beherbergt, bei vielen anderen Säugetieren jedoch nur eine einzige, d. i. die obere Olive. Ferner ist bei *Cebus capucinus, Nemestrinus nemestrinus* und *Latax lutris* eine Fältelung oder Bänderung am Corpus geniculatum mediale in seinem ventrolateralen Kerngebiet wenn auch schwach doch deutlich angedeutet.

T. Ogawa.

216. Über strukturelle Eigenheiten am vorderen Zweihügel des Seiwals (*Balaenoptera borealis* Less.) Gennosuke FUSE. [Arb. Anat. Inst. Sendai, **17** (1935), 203-227, 7 Taf.] — Im Vorderhügel des Seiwals sind architektonisch 7 Strata zu unterscheiden, von welchen die Cappa cinerea mit ungewohnlich grossem Sagittaldurchmesser, der dem ganzen Vorderhügel entspricht, dann das sehr mächtig ausgebildete Stratum medullare superficiale und das Stratum compactum cellularum, s. Nucleus taeniaeformis, welchen Namen Verf. für das eigenartig entwickelte Stratum medullare medium s. Stratum lemnisci dieses Tiers zuerst brauchte, ohne weiteres vor dem der anderen Säugetiere auszeichnen. In der starken Entwicklung der Cappa cinerea und des Stratum medullare superficiale weicht also der Vorderhügel des Seiwals von den Bemerkungen Hatschek-Schlesingers über Delphinhirn hochgradig ab. Das Str. compactum cellularum ist ein sich von der oralen Höhe des Hinterhügelganglions bis zur kaudalen Anfangshöhe der Commissura posterior erstreckender, zum Teil segmentierter Zellband, der aus dicht zusammengefügten mittleren und kleineren Nervenzellen besteht und durch eine scharfe Markkapsel begrenzt wird. Dieser Kern verbindet sich mit dem Str. gris. med. sehr innig, entsendet viele Bogenfasern in die Vorderhügelkommissur und die laterale Randpartie des Zentralhöhlengraus und nimmt dazu noch Fasern aus dem Str. medull. superf., dem Hinterhügelganglion und der Hinterhügelkommissur zu sich auf. Verbindung dieses Stratums mit der medialen Schleife ist fraglich. Über das Wesen dieser eigentümlichen grauen Masse ist Verf. vorläufig der Ansicht, dass sie dem Nucl. olivaris corp. quadrigem. ant., den er seit 1916 beim Menschen, vielen Affen und manchen Karnivoren gefunden hat, gleichzusetzen ist.

T. Ogawa.

217. Über die Regeneration von Augenbechern an verschiedenen Körperstellen durch isolierte Irisstücke. Yoshindo IKEDA. [Arb. Anat. Inst. Sendai, **17** (1935), 12-54] — Es wurde an Larven von *Hynobius unnangso* und von *H. fuscus* sowie an erwachsenen *Diemyctylus* die Fähigkeit der Iris zur Regeneration des Retinagewebes auf dem Wege der homoplastischen sowie hetero- und xenoplastischen (dazu dienten auch Larven von *Rana fusca* als Wirt) Implantation an verschiedenen Stellen — in Auge, IV. Ventrikel, Bauchhöhle und mesodermalen Gewebe — geprüft. Verf. hebt hervor, dass das isolierte Irisstück von *Hynobius* die Fähigkeit besitzt aus sich selber, einen Augenbecher von ziemlich vollständiger Gestaltung zu regenerieren, welche Fähigkeit im dorsalen Irisbezirk grösser als im ventralen und bei *H. fuscus*-Larven bei weitem stärker als bei *H. unnangso*-Larven ist. Für die Regeneration des Augenbechers sind die Implantationsstellen in folgender Reihe geeignet: Bulbushöhle, Bauchhöhle, Hirnventrikel und mesodermales Gewebe. Die Regenerationsgeschwindigkeit der Retina zu ihrer histologischen Ausdifferenzierung ist im allgemeinen desto grösser, je jünger das Versuchstier, je günstiger die Implantationsstelle und je kleiner der Abstand der Tierarten von Wirt und Spender ist. Bei Implantation in Hirnventrikel und Bauchhöhle stellt das Regenerat zusammen mit dem Implantat einen mit Hohlraum versehenen Becher mit aussen bedeckendem Neuroepithel dar oder das

Implantat kugelt sich ab und wird durch das Regenerat, dessen Neuroepithel innen liegt, kapselartig überzogen. Bei Implantation im Auge und mesodermalen Gewebe entsteht entweder ein hohler Becher mit innen liegendem Neuroepithel oder das Implantat wird schalenförmig gebogen, wobei das Regenerat die Innenfläche des Implantates auskleidet. Das regenerierte Retinagewebe wird in der ganz überwiegenden Mehrzahl der Fälle von der implantierten Pars iridica retinae aus durch Umdifferenzierung neugebildet; manchmal wird jedoch entweder ein Teil oder das Ganze des Regenerates auch von Tapetumzellen aus durch Metaplasie gebildet. Nicht selten, und zwar nur nach Implantation des dorsalen Irisstückes bemerkte Verf. Bildung der Lentoide im Regenerat und auch im Tapetum, wobei er als erster die direkte Umwandlung der ausdifferenzierten Tapetumzellen in Faserzellen der Linse feststellen konnte. T. Ogawa.

218. Über die Verdauungsorgane der Kaulquappe bei der Metamorphose. (Japanisch.) Tsunekichi IWANE. [Hokuetsu Igk. Z., Niigata, **50** (1935), 1236-1247, 2 Fig.] — Verf. beobachtete histologische Veränderungen des Magens, des Darmes und der Leber bei Metamorphose des Frosches. Am Magen kommt zuerst Rückbildung des Oberflächenepithels und der Drüsenausführungsgänge vor. Mit der Verkleinerung des ganzen Magens werden dann viele Schleimhaut falten gebildet, wodurch das Epithel gruppenweise abgestossen wird. Vom mittleren Stadium der Metamorphose an findet rasche Vermehrung der Epithelzellen des Drüsengrundes statt. Muscularis mucosae, Submucosa, starke innere und äussere Muskellagen treten auch in dieser Periode auf. Im Darm fällt besonders die hochgradige Verkürzung seiner Länge auf, und damit in Zusammenhang Verdickung der Muskelschicht und massenhaftes Abstossen des Epithels. Vom letzteren bleiben nur die Ersatzzellen übrig, welche die Oberfläche der Tunica propria lückenhaft bedecken; sie weisen Mitochondrien und Pyroningranu'a auf, reagieren aber bei Eisen-, Glykogen- und Fettfärbung negativ. Nach Verf. bedeutet die Existenz der Pyroningranula die lebhafte Aktivität der Zelle. In der Leber vermindert sich Glykogen bis zu völligem Schwund, während Mitochondrien, Fett und Eisen während der Metamorphose immer vermehrt wird. Besonders zeichnen sich die Kupfferschen Sternzellen durch hohen Eisengehalt aus.

T. Ogawa.

219. Eisenreaktion des Amphibiendarmes bei Winterschlaf und Metamorphose. (Japanisch.) Tsunekichi IWANE. [Hokuetsu Igk. Z., Niigata, **50** (1935), 487-516, 1 Taf.]— Därme von *Diemyctylus pyrrhogaster, Rana* und *Gecko* (Reptilia), welche man in verschiedenen Jahreszeiten (Anfang Mai, Mitte August, Mitte November und Mitte Februar) gefangen hat, sind nach Perlscher Berlinerblau- und Hueckscher Turnblaufärbung behandelt. Die Resorption des Eisens findet hauptsächlich im Duodenum statt, während Exkretion desselben bei Tieren mit schmächtig angelegtem Caecum zum grössten Teil im Rektum und im oberen Teil des Hinterdarms geschieht. Beim Frosch dringen aber mit reichlichem Eisen beladene freie Zellen aus der Submucosa und Propria ins Epithel ein und lösen da auf, womit die Ausscheidung des Eisens zum Teil erzielt wird. Nach Jahreszeiten schwankt der Eisengehalt des Darmkanals merkwürdig: im Sommer spärlich, im Winterschlaf dagegen reichlich. Ähnliche jahreszeitliche Schwankung zeigen auch die Glykogen- und Fettvertelung. Bei der Metamorphose wird das durch Verkleinerung der verschiedenen Gewebe überflüssig gewordene Eisen zum geringen Teil von Niere abgeschieden, zum Teil temporär in gewissen Organen aufgespeichert, um später allmählich im Körper benützt zu werden. Der grösste Teil von ihm wird aber aus dem Verdauungskanal abgeschieden. Dabei reagieren Epithel und freie Zellen zur Eisenreaktion stark positiv. Im regenerierten Epithel kurz nach der Metamorphose bemerkt man kein Eisen.   T. Ogawa.

220. Rückbildung des Kaulquappenschwanzes bei der Metamorphose. (Japanisch.) Tsunekichi IWANE. [Hokuetsu Igk. Z., Niigata, **50** (1935), 999-1024, 1 Taf.] — Verf. applizierte Hämatoxylin-Eosin-, Unna-Pappenheim-, Glykogen-, Altmann-Kull-, Eisen- und Lipoidfärbung an metamorphosierenden Kaulquappen (*Rana, Bufo*). Er beschreibt die Veränderungen verschiedener Organe (Haut, Muskel, Chorda, Rückenmark etc.) in 5 aufeinander folgenden Stadien: 1. Stadium, in dem hintere Extremitäten auftreten; 2. Stad., in dem vordere Extremitäten erscheinen; 3. Stad. mit wellig gekrümmtem Schwanz; 4. Stad. mit beträchtlich verkürztem Schwanz; 5. Stad., mit Schwanzspur. Histologisch kommt die Rückbildung schon im 1. Stad. an subkutanen Blutgefässen nahe der Schwanzspitze zum Vorschein. Im 3. Stad. treten regressive Veränderungen der

Muskeln am auffallendsten auf. Einzelne Muskelfasern schwellen hier und da knotig an; Myofibrillen verändern sich in Anordnung und Färbbarkeit und zerfallen dann in Sarcolyten; das Sarcoplasma scheint an diesen Knoten und in der Nähe des Myoseptums zugenommen zu sein, was Verf. nicht für Vermehrung sondern für Anschwellung des Sarkoplasmas hält. Lipoidfärbung wird stärker positiv an diesen Stellen. Die Kerne vermehren sich durch direkte Teilung innerhalb der rückgebildeten Muskelfasern, welch letztere sich dann in die sog. muskulösen Phagozyten umwandeln. Die muskulösen Phagozyten haben nach Verf. keine aktive Wanderungsfähigkeit. Epidermis verdickt sich während der Metamorphose zu 6 bis 7 Zellschichten. Im 4. Stadium sind alle Gewebe innerhalb der Epidermis schon hochgradig verändert, Zellen der Muskeln, Chorda, Rückenmarks und Drüsen unregelmässig beimischt in der Gewebsflüssigkeit schwebend. Die Eberthsche Struktur bemerkt Verf. nicht nur in basalen sondern auch in ganz oberflächlichen Epidermiszellen und deutet sie als Stutzapparat der Zellen.   T. Ogawa.

221. Experimentelle Studie über die Pyramidenbahn bei Affen. (Japanisch.) Kingo KATOH und Seibun UCHISHIMA. [Hokuetsu Igk. Z., Niigata, **50** (1935), 977-991, 1 Taf.] — Durch elektrische Kauterisation wurden bei 2 Affen (*Cercopithecus*) die Areae 4a (unten 2/3), 4b und 4c der linken Hemisphäre zerstört und die sekundäre Degeneration der folgenden Bahnen wurde nach Marchischem Verfahren im Rückenmark nachgewiesen. Die gekreuzte laterale Pyramidenbahn (a) macht den grössten Teil der ganzen Pyramidenfasern aus und lässt sich bis zum kaudalen Ende des Rückenmarks bemerken. Man kann auch die gleichseitige laterale Pyramidenbahn (b) durch die ganze Höhe des Rückenmarks verfolgen, obwohl sie bedeutend schwächer entwickelt ist als (a). Die gleichseitige vordere Pyramidenbahn (c) ist inkonstant in ihrer Existenz, weil sie nur bei einem Affen entlang der Fissura mediana ant. bis zum 7. Brustmark konstatiert wurde; beim anderen Affen fehlte sie vollständig. Ausserdem unterschieden Verff. 2 Bahnen, gekreuzte und gleichseitige dorsolaterale Pyramidenbahn (d, e), welche nach der Oberfläche des Rückenmarks im Bezirk der Flechsigschen Bahn verlaufen. Jene Bahn lasst sich von dicht unterhalb der Pyramidenkreuzung bis zum 3. und 4. Thorakalsegment verfolgen, während diese ganz spärlich entwickelt ist und schon im unteren Halsmark verschwindet. Die dorsolateralen Pyramidenbahnen sind weder mit der ventrolateralen Pyramidenbahn (Barnes, Yamakawa) noch mit den accessorischen Pyramidenbündel (Probst) identisch.   T. Ogawa.

222. Vergleichend-anatomische Studie über den Nucleus entopeduncularis. (Japanisch.) Kenji MATSUMOTO. [Hokkaido Ig. Z., Sapporo, **13** (1935), 1230-1264 u. 1361-1378, 6 Taf.] — Eingehende vergleichend-anatomische Beobachtung an Gehirnen einer grossen Anzahl Mammalien. Verf. ist der Meinung, dass sich der Nucleus entopeduncularis bei Tieren, deren Bewegungen aktiv auf grossen Umfang vorkommen, z. B. bei Karnivoren, am besten entwickelt ist, während dieser Kern bei Tieren, welche träge Bewegungen im relativ beschränkten Gebiete ausführen, z. B. bei Huftieren und Insektivoren, nur schwach angelegt ist. Etwa den mittleren Entwicklungsgrad bieten der grössere Teil der Rodentien und *Macropus* dar. Bei gewissen Tieren (*Ursus, Putorius, Canis, Lutra, Phoca, Callorhinus* etc.), deren Nucleus entopeduncularis beträchtlich gut entwickelt ist, liegt der orale Teil dieses Kerns dicht medial vom Globus pallidus, sich dem inneren Glied des letztgenannten Kerns bei den Primaten sehr ähnlich verhaltend. Nach diesem Befund kann der innere und äussere Glied des Globus pallidus der Primaten wesentlich voneinander verschieden sein. Der äussere Glied stammt wahrscheinlich aus dem Ganglienhügel des Telencephalons ab, während der innere Glied aus Diencephalon entstanden zu sein scheint. Ausserdem zeigt nach Verf. der Nucleus entopeduncularis keine direkte Beziehung mit Ganglion basale Meynerti. Dagegen ist naher Zusammenhang zwischen Nucleus entopeduncularis und Corpus Luysii bei einigen Tieren (*Macropus, Putorius, Phoca, Callorhinus*) zu bestätigen.   T. Ogawa.

223. Über die histologischen Veränderungen der endokrinen und anderer Organe des Kaninchens bei der Injektion des Gravidenharns. (Japanisch.) Hiroshi NIIZUMA. [Hokuetsu Igk. Z., Niigata, **50** (1935), 671-778, 890-937.] — Nach Injektion des Harns der schwangeren Frauen auf normalen, schwangeren oder kastrierten Kaninchen wurden verschiedene Organe (Hypophyse, Schilddrüse, Nebenniere, Ovarium, Leber und Pankreas) histologisch sehr eingehend und systematisch untersucht. Ausgeprägte Veränderungen lassen sich im Vorderlappen der Hypophyse, Schilddrüse, Nebennierenrinde, Langerhansschen Inseln des Pankreas etc. nach

kurz dauernder Injektion bemerken. Dabei lenkte Verf. bezüglich der Hypophyse besondere Aufmerksamkeit auf grosse, mit eosinophilen Körnern beladene, unscharf begrenzte Zellen, welche den sog. Schwangerschaftszellen ähnlich sind und in Anzahl die anderen Zellarten (basophile und eosinophile Zellen) übertreffen; die Hauptzellen fehlen dabei fast vollständig. In der Schilddrüse fallen besonders Vermehrungen der kleineren Follikeln und der chromophilen Kolloide auf. In der Nebennierenrinde ist die Hypertrophie und Zellvermehrung der Zona glomerulosa bestätigt. Langerhansschen Inseln werden in Zahl vermehrt und in Gestalt unregelmässig; ihre Zellen selbst erscheinen etwas atrophisch. Im grossen und ganzen sind die Veränderungen, welche verschiedene endokrine Organe bei relativ kurz dauernder Injizierung des Gravidenharns aufweisen, dem echten Schwangerschaftszustand ziemlich ähnlich. Ausserdem betont Verf. dass diese Organe bei lang dauernder Injektion die Neigung zeigen, zum normalen Zustand zurückzukehren.

<div align="right">T. Ogawa.</div>

224. Über den Olivenkern des Vorderhügels, Nucleus olivaris corp. quadrigem. ant., beim Hunde. S. OHASHI. [Arb. Anat. Inst. Sendai, **17** (1935), 183–194, 3 Taf.] — Verf. beschreibt eingehend über den früher von G. Fuse beim Menschen und verschiedenen Affen entdeckten Olivenkern des Vorderhügels beim Hunde. Ausdehnung, Lage, Fältelungsweise, Architektur und hodologische Verhältnisse wurden berücksichtigt. Dieser gefaltete Kern lässt sich auf der oralen Höhe des Vorderhügels, und zwar da, wo die Pars dorsalis der Commiss. post. deutlich entwickelt ist, erkennen, wobei er zum grössten Teil im Str. gris. med. namentlich im Bezirk zwischen der Fossa epiphyseos des Vorderhügels und dem Pulvinar, zum kleineren im Str. medull. superf. untergebracht liegt. Er erscheint durch seine gelatinöse und karminophile Grundsubstanz gegen die Umgebung sehr scharf abgegrenzt und darf nach Verf. nicht mit den von anderen Autoren bei verschiedenen Tieren berichteten Kernen, z. B. Nuclei pretectalis, tractus optici, lentiformis mesencephali, limitans, para- oder suprageniculatus, verwechselt werden.

<div align="right">T. Ogawa.</div>

225. Vergleichende Studie über die ausgebildete Plazenta der Rodentien. (Japanisch.) Yoshika OHASHI u. Tsunekichi IWASE. [Hokuetsu Igk. Z., Niigata, **50** (1935), 1357–1363] Eine Zusammenfassung der Ohashischen Arbeiten über die Plazenta der Maus und der Iwaneschen über die des Meerschweinchens und Kaninchens. Die Struktur der ausgebildeten Plazenta ist in dieser Abhandlung zwischen drei obengenannten Tieren vergleichend-anatomisch näher betrachtet. Als allgemeiner Schluss sind Verff. der Meinung, dass während der Entwicklung der Plazenta die Decidua, obwohl sie anfangs wächst und Glykogenzellen entstehen lasst, später durch Gewebe der foetalen Seite allmählich zerstört wird, so dass die fertige Plazenta ausgenommen des aus der Mutter gekommenen Blutes zum grössten Teil als dem Foetus zugehörend anzusehen ist.

<div align="right">T. Ogawa.</div>

226. Die Fasersystematik des Grosshirns mit besonderer Berücksichtigung des Thalamuskerns mit der Rinde. (Japanisch.) Taiji OHKUMA, Tatsu ISIZIMA und Takashi HISIKI. [Seishin-Shinkei Z., Tōkyō, **39** (1935), 342–347.] — Experimentell am Kaninchen, Katzen und Affen (Makakus) studierten Verff. die sekundäre Degeneration nach Marchischer und Nisslscher Methode und stellten bezüglich der Faserverbindungen der vorderen Thalamuskerns folgendes fest, dass Faseraustausch zwischen des Area retrosplenialis einerseits (Rap Roses, 29 a-d Brodmanns) und den Ad+Av andererseits (Nucl. ant. thal. und Nucl. ant. vent thal.) existiert, weiter dass thalamo-kortikale Fasern vom Nucl. ant. med. thal. (Am, me mi Nissls) ausschliesslich in die Area fornicatus (IR Roses, 23+24 Brodmanns) einstrahlen, wobei der kaudale Teil des Kerns mit der vorderen Hälfte der Area IR, sein oraler Teil mit der hinteren Partie der IR verbunden ist. In bezug auf die relative Grösse des einzelnen Abschnittes des vorderen Thalamuskerns bei verschiedenen Säugern (Kaninchen, Hund und Affe) waren Verff. der Ansicht, dass dieser Kern bei Nagetieren höchst entwickelt ist, während er bei Carnivoren sowie bei Primaten an Entwicklung stufenweise zurückzutreten neigt, und dass bei Primaten nicht nur Ad winzig entwickelt ist, sondern auch Av von Am schwer differenzierbar ist, wobei sich Av nur mit grosser Mühe als ein kleiner Zellhaufen im lateralen, oberen Teil des vorderen Thalamuskerns nach der relativen Dichte der Zellgruppierung sowie der Armut der Dendriten mit demjenigen der anderen Säuger identifizieren lässt. Nach Verff. wäre es berechtigt anzunehmen, dass Av+Am bei Primaten, insbesondere bei Menschen, vornehmlich aus Am bestehen.

<div align="right">T. Ogawa.</div>

227. Beiträge zur Entwicklungsgeschichte der Wirbelsäule und Rückenmarkshäute. I. Mitt. Über die Entwicklung des Mesoderms, der Chorda dorsalis und Hypochorda bei Riesensalamander (*Megalobatrachus japonicus*). (Japanisch.) Keizaburô SHIMBÔ. [Hokuetsu Igk. Z., **50** (1935), 413–470.]—Material: Eier, Larven und erwachsene Tiere des Riesensalamanders aus Okayama. An der Bildung des Mesoderms beteiligt sich nicht nur Entoderm sondern auch Ektoderm. Es entwickelt sich aus der inneren Grenzzone der Urmundlippen, wobei sich auch Zellen aus der äusseren Grenzzone an der Bildung der Mesodermanlage beteiligen. Anfangs bildet das Mesoderm eine solide Zellmasse, besitzt keine Mesodermbildungsrinne, welche offen mit der Urdarmhöhle kommuniziert. Das Mesoderm kommt immer zuerst peristomal zum Vorschein und verlagert sich von hinten nach vorn. Das viscerale Mesoderm wird also weder durch die ventrale Verlängerung des axialen Mesoderms, noch durch die Ausstülpung des Entoderms resp. einfache Fältelung des Urdarmdaches gebildet. Genetisch zeigt die Chorda dorsalis mit allen Keimblättern innigen Zusammenhang; ihre Differenzierung kommt zuerst im Rumpfteil besonders im Halsgebiet vor, schreitet dann nach Kopf und zuletzt nach Schwanz fort. Die Hypochorda entsteht wahrscheinlich aus dem Mesoderm, und zeigt innige Beziehung mit dem Sklerotom. Sie wird zuerst bei der 7,5 mm langen Larve bemerkbar und verschwindet bei der 35,9 mm langen Tier. Die Vakuolenbildung in Chordazellen beginnt zuerst bei der 10,0 mm langen Larve im Rumpfteil und schreitet allmählich kranial- und kaudalwärts fort. Der Chordaknorpel entwickelt sich aus Chordaepithelzellen; vakuolisierte Chordazellen scheinen sich nicht in Knorpel umzuwandeln. Beim erwachsenen Tiere verschwindet die Chorda dorsalis des Kopfes zuerst im atlantookzipitalen Gebiet und später im übrigen Kopfteil.

<div align="right">T. Ogawa.</div>

228. Beiträge zur Entwicklungsgeschichte der Wirbelsäule und Rückenmarkshäute. II. Mitt. Über die Entwicklung der Wirbelsäule und Rückenmarkshäute bei Riesensalamander (*Megalobatrachus japonicus*). (Japanisch.) Keizaburô SHIMBÔ. [Hokuetsu Igk. Z., **50** (1935), 536–602.) — Der grosste Teil des kranialen Hemisklerotoms bringt nach Verf. den Intervertebralknorpel hervor, während sich der grösste Teil des kaudalen Hemisklerotoms an der Bildung des oberen Bogenknorpels beteiligt. Der obere Bogen wird durch den grössten Teil des kaudalen Hemisklerotoms eines Urwirbels und einen Teil des kranialen Hemisklerotoms des nächst folgenden Urwirbels gebildet. Die Anlage des Tuberculum interglenoidale entsteht durch Verknorpelung des äusseren Chordascheide, d. h. Verdickung des Intervertebralknorpels und vereinigt sich später kurz vor der Metamorphose mit dem aus dem Atlaskörper verlängerten Chordaknorpel. Verf. leugnet die Meinung ab, dass Atlas durch Verschmelzung zweier Wirbel, Atlas und Proatlas, entstanden ist. Die Anlage der Zacken des Lig. denticulatum lässt sich in Meninx primitiva schon zur Zeit nachweisen, wenn Dura mater noch nicht differenziert ist, und zeigt dabei direkte Beziehung mit den Zellen der oberen Bogenanlage. Die Bildung und Differenzierung der Rückenmarkshäute scheinen durch die Ungleichheit der Entwicklung zwischen Rückenmark und Wirbelkanal und durch die Verlagerung der Spinalganglien und -nervenwurzeln beeinflusst zu werden. Die Rückenmarkshäute entstehen wahrscheinlich aus dem osteoblastischen Gewebe; ihre Entwicklung geschieht in folgender Weise.

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                            ┌─Endorrhachis─┐  ┌─Endorrhachis + Dura mater
                          ┌─┤              │  ├─Subduralraum
                          │ └─Duralamelle ─┘  └─Subduralraum
Meninx primitiva─┤        │                   ┌─Arachnoidea
                          │                   │
                          └─ Meninx secundaria──Subarachnoidalraum
                            └─Pia mater.
```
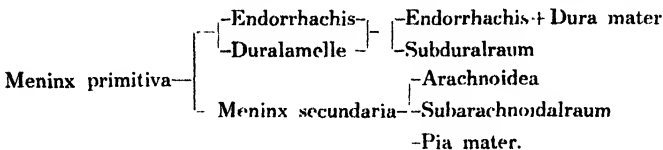
<div align="right">T. Ogawa.</div>

229. Beitrag zur Entwicklungsgeschichte des Beckens beim Riesensalamander (*Megalobatrachus japonicus*). (Japanisch.) Keizaburô SHIMBÔ. [Hokuetsu Igk. Z., **50** (1935), 1150–1166.] — Bei Riesensalamanderlarven bestätigte Verfasser 3 Knorpelzentren, welche die erste Anlage des Ileum, Pubis und Ischium darstellen. Er bemerkt weiter, dass sich ein dem Epipubis der Reptilien entsprechender Knorpelfortsatz beiderseits aus der Pubisanlage entwickelt und die beiderseitigen Fortsätze miteinander zu einem mit dem Beckenknorpel zusammenhängenden dreieckigen kurzen Fortsatz verschmelzen. Ausserdem entsteht in der Linea alba die Cartilago

ypsiloides anfangs als eine isolierte Anlage, wächst dann allmählich kranial- sowie kaudalwärts und vereinigt sich mit dem obengenannten Knorpelfortsatz der Pubissymphyse, wodurch der Processus epipubicus gebildet wird. Verf. ist der Meinung, dass der Proc. epipubicus des Riesensalamanders dem gleichnamigen Gebilde der Dipnoi, Selachier und Reptilien nicht homolog, obwohl er mit diesem sehr ähnlich aussieht. Die Cartilago ypsiloides dient wahrscheinlich als Ansatzstelle der Bauchmuskeln und als Stütz- und Verstärkungsapparat der Bauchdecke, in Anpassung an die bei Lokomotion beiderseits alternativ vorkommenden kräftigen Bewegungen der Bauchmuskeln bei diesem Tiere.   T. Ogawa.

230. Studien über die Eigenschaften der Koɴschen Silbergranula der Leberzellen. I. Mitt. Phylogenetische Studie. II. Mitt. Ontogenetische Studie. Toshio SUZUKI. [Hokkaidô Ig. Z., **13** (1935), 2185–2201, 2339–2353.] — Bei frischer und fixierter Leber der Mammalien (Rind, Pferd, Schwein, Hund, Kaninchen, Meerschweinchen), Vögel (Huhn, Taube), Reptilien (Schlange, Schildkröte), Amphibien (Frosch) und Fische (Karpfen) untersuchte Verf. die färberischen Charaktere der Koɴschen Silbergranula bei Fixierung mit verschiedenen Säure- und Alkalikonzentrationen. Bei Mammalien und Reptilien treten diese Granula nach Fixation mit Säure-Formol deutlich auf, wobei ihre Färbbarkeit mit Azidität der Fixierungsflüssigkeit parallel aufsteigt, während bei Vögeln, Amphibien und Fischen die Koɴschen Silbergranula nur nach Fixation mit Alkali-Formol zum Vorschein kommen. Ontogenetisch sind diese Granula beim Kaninchen zuerst im 3-wöchigem Foetus, und zwar anfangs nur nach Fixation mit Alkali-Formol darstellbar, während die bei Behandlung mit Säure-Formol gegen Silber positiv reagierenden Granula erst nach Laufe der I. extrauterinen Woche erscheinen und schon einige Wochen später davon der Zustand erwachsener Kaninchen erreicht wird. Mit der Differenzierung der Leberzellen, phylo- sowie ontogenetisch verschiebt sich also die Färbbarkeit der Koɴschen Silbergranula von der Seite der Säurefixation zu der der alkolischen. Ausserdem vergleicht Verfasser näher die färberischen Eigenschaften zwischen den Koɴschen und den mit Dahlia darstellbaren Granula.
                                    T. Ogawa.

231. Über die aus der Area (22) der Grosshirnrinde entspringenden, kortikalen extrapyramidalen Fasern bei Katze. (Japanisch.) Seibun UCHISHIMA. [Hokuetsu Igk. Z., **50** (1935), 1282–1316, 2 Taf.] — Nach Kauterization der Area (22) der linken Grosshirnhemisphäre wurde bei Katze sekundäre Degeneration in die folgenden subkortikalen Gebiete verfolgt: Nucl. caudatus (Caput et Cauda), Putamen, Pallidum (externum), Thalamus (Nucl. lateralis et Pulvinar), Corp. genicul. lat. et med., Subst. nigra (besonders deren dorsolateraler Teil), Str. intermed. (besonders dessen dorsolateraler Teil), Corp. quadrig. sup. (besonders Str. zonale et Str. opticum), Corp. quadrig. inf. (besonders Str. zonale), Tract. temporopont. etc. Die im Nucl. caudatus endigenden Fasern sind fein und spärlich und ziehen durch das Str. subcallosum und Str. zonale uncl. caudati, während die nach Putamen hinziehenden zum grössten Teil durch die Capsula externa, zum Teil aber auch vom Centrum semiovale unmittelbar in diesen Kern eindringen. Diese Fasern sind ebenfalls sehr fein, aber in Zahl grösser als jene. Verf. schliesst, dass die Area (22) des Katzenhirns ein der Hirasawaschen kortikalen extrapyramidalen Zentren ausmacht, weil sie sich mit vielen obenerwähnten subkortikalen Zentren innig verbindet.   T. Ogawa.

232. Über die zytoarchitektonische Gliederung des roten Kerns der Ratte. (Japanisch.) Yatarô YAMAGISHI. [Hokuetsu Igk. Z., **50** (1935), 845–851, 1 Taf.] — Früher hat Verfasser seine Untersuchungen über den Nucleus ruber anderer Säugetiere (Katze, Hund, Kaninchen, Maus, Meerschweinchen) öffentlich gemacht. Architektonisch ist der rote Kern auch bei der Ratte in einige Unterkerne zu unterscheiden, von welchen Nebenkerne (e, e′, e″) seitlich von Hauptkernen (v, d, p) zuerst getrennt von diesen in der mittleren Höhe zum Vorschein kommen, sich aber weiter frontalwärts mit Hauptkernen vereinigen. Der rote Kern lässt sich im frontaleren Niveau gegen die Umgebung besonders gegen die Nucl. interstitialis Cajal unscharf begrenzen.   T. Ogawa.

233. Some Observations upon the Mitotic and Meiotic Divisions in the Wistar Rat. I. The Effect of Changes in Temperature. Wm. BRYDEN. [Cytologia 6 (1935).] — The present work was carried out in conjunction with cytological studies on chiasma frequencies and allied investigations on the rat, and any interpretation of figures presented, is based

on the theories of Jansens and Darlington. All the animals used for material were of similar genetic constitution closely related and of similar age — 9 weeks. The results of Kemp and Juul, Bleier and Heilborn appear to be parallel in the study. Changed environments have the effect of checking the division and from observations made it appears that the chromosomes are urged to take up a position on the metaphase plate or the completed anaphase division to escape any deleterious effects from the enforced new conditions. Observations on the chiasma frequencies show some divergence from the control figures. The counts and interpretation of figures are merely given (for what they may be worth) to compare the cytogenetical side with the purely cytological aspect. From the chiasma frequencies and frequencies of bivalent types it appears that the mechanism of chromosome movement, chiasma formation, terminalisation etc., are all affected by the experimentally produced environments. No degeneration of testes was noticed in the tests carried out, but it must be remembered that the treatments were never continued for more than 10 hours.   Sh. Suzuki.

234. **Studien des Corpus luteums durch die Transplantation des Uterus. III. Untersuchungen bei gleichzeitiger Autoplastik des Ovariums und Uterus.** (Japanisch.) T. FUJIWARA. [Osaka Igk. Z., **34** (1935).] — Das Ovarium und der Uterus wurden bei Kaninchen nach der Kastration in die Niere, Milz und ins grossen Netz autoplastisch verpflanzt. Bei so vorbehandelten Kaninchen wird durch die Injektion des Schwangerenharns das Corpus luteum im verpflanzten Ovarium gebildet, welches nicht nur auf den Uterus von normaler Lage, sondern auch auf den transplantierten einwirkt. Und diese Einwirkungen auf den letzteren werden durch die Vorbehandlung des Wirtes mit dem Ovarialhormon nach der Verpflanzungsoperation weiter verstärkt. Als Transplantationsstelle des Ovariums bei diesen Untersuchungen sind die Niere und Milz viel passender als das grosse Netz.   Sh. Suzuki.

235. **Histologisch-anatomische Untersuchungen des Zwischenhirns, besonders des sogenannten Wärmeregulationszentrums bei Meerschweinchen. I. Mitteilung. Über den feineren Bau des Zwischenhirns vom Meerschwein.** (Japanisch.) H. HASEGAWA. [Osaka Igk. Z., **34** (1935).] — Durch der Eosin-Thionin-Färbung von Verfasser u. a. werden die a-, a'-, b- und c-Zellengruppen von Hypothalamus von Horimi u. a. ganz aufs neue in zwei Arten eingeteilt: in Hellzellen- und Eosinophilzellengruppen. Zu erster gehören a- und b-, während c- und a'-Gruppen zur letzten. Die Kerne von Hypothalamus ausser den drei obengenannten und dem Corpus mamillare nehmen bei gleichen Bedingungen gegen die Eosin-Thionin-färbung ganz gleiche Stellung wie die obengenannten. Nicht nur im Hypothalamus, sondern auch im Zwischenhirn als ganzes werden die Zellen von c-Gruppe meistens an der Stelle gefunden, wo sowohl Nervenfaser wie auch durch Markscheidenfärbung gefärbte Zellen auch sehr reichlich vorhanden sind. Medial von der absteigenden Fornixsäule wird ein kleiner, zirkumscripter Kern gefunden, den der Verfasser Nucleus tuberis circumscripta nennt. Dieser Kern scheint nach dem Verfasser das eigentümliche Vorhandsein im Meerschweinchen zu sein und ist vom Nucleus inter-calatus scharf zu unterscheiden. Der mediale Kern von Ganglion habenullae enthaltet vielleicht keine Nervenzellen. Der Nucleus paraventricularis scheint mit dem Nucleus medialis anterior in engerem Zusammenhang zu stehen.   Sh. Suzuki.

236. **Histologisch-anatomische Untersuchungen des Zwischenhirns, besonders des sogenannten Wärmeregulationszentrums bei Meerschweinchen. II. Experimentelle Untersuchungen über die Lokalisation des sogenannten Wärmeregulationszentrums im Zwischenhirn des Meerschweinchen.** (Japanisch.) H. HASEGAWA. [Osaka Igk. Z., **34** (1935).] — Der Verfasser hat die Lokalisation des sogenannten Wärmeregulationszentrums ge-sucht um es histologisch zu untersuchen. Resultate lauten etwa folgendermassen: Die zyto-logische und histologische Veränderungen in der sogenannten Wärmeregulationszentrumsregion durch Wärmestich sind durch den Färbungen von Thionin oder Thionin-Eosin gar nicht wahr-nehmbar. Balken, Psalterium, Ammonshorn u. a. reagieren gegen den Wärmestich gar nicht. Das gilt von allen Kernen des Thalamus ausser dem Nucl. med. ant. dem Kern d. Mittellinie. Die gegen den Wärmestich empfindlich reagierende Stelle liegt im Hypothalamus in der Region von b. Zellengruppe, besonders Pars ventromedialis von ihnen. Im lateralen Teil der hinteren Hälfte von Hypothalamus befindet sich auch eine gegen Wärmestich empfindliche Stelle, wodurch die sich an der Wärmeregulation beteiligenden Faser wahrscheinlich auch passieren.

                                                                   Sh. Suzuki.

237. Über das gröbere Blutgefässystem des Kaninchenmarkes. M. HASHIMOTO.
[Nihon Byori K. **25** (1935).] — Als Untersuchungsmaterial wurde das Knochenmark von aus-
gewachsenes Kaninchens benutzt. Zur Beobachtung des gröberen Gefässystems wendet Verf.
ausser der graphischen Rekonstruktion aus dem Zelloidinserienschnitten makroskopische und
mikroskopische Untersuchung der mit Xylol durchscheinend gemachten Knochenpräparaten an.
Im Knochenmark befindet sich ein wurstförmig erweiterter Venenstamm, und dieser erscheint
wie ein Blutreservoir im Knochenmark. In diesem Sinne benannte Verf. ihn „Flutvenenstamm".
Die Wandstruktur der durch einen nutritiven Kanal passierenden Vene zeigt eine auffallende
Besonderheit. d. h. ihre äusseren Wandbestandteile schwinden allmählich in ihrem Verlauf nach
medullarwärts und nur ihre innerste Endothelschicht verbindet sich mit der des Flutvenenstammes.
Die Wandstruktur des venösen Gefässstammes zeigt keinen gewöhnlichen Venenwandbau, sondern
besteht nur aus einer einschichtigen Endothelschicht, welche fast die gleiche Beschaffenheit besitzt
wie die des Venensinus des Reticuloendothelzellsystems. Jeder Teil des Langröhrenknochens
(Körper, Diaphyse und Metaphyse) hat eigentlich seine Knochenmarkgefässe, die ihre charak-
teristische Beschaffenheit besitzen. Im Knochenmark des langen Röhrenknochenkörpers umschlingen
die Arterienäste den Flutvenenstamm dicht an seiner Wand.   Sh. Suzuki.

238. Vergleichend-anatomische Untersuchungen der Lymphe. (Japanisch.) I. HAMA-
DA. [Kyoto Ig. Z., **32** (1935).] — Verf. hat als erster Tritt des übergeschriebenen Thema
morphologische Untersuchungen der Lymphe der Kröte ausgeführt und folgende Ergebnisse be-
kommen: — Die Zellenzahl der Lymphe ist im Vergleich mit derer der Säugetiere viel kleiner,
und beträgt durchschnittlich 2197 per cmm. Die individuelle Schwankung der Zellenzahl ist auch
relativ geringer, d. h. 1920 bis 2660 per cmm. Es gibt keine Verschiedenheit im Sommer und
Winter. Es gibt keine nennenswertige Schwankung in der Lymphe, während im Blut erhebliche
Schwankung zu sehen ist. Die Zellen der Krötenlymphe sind bedeutend reich an Arten und er-
halten alle Blutzellen mit Ausnahme von der roten Blutzellen und Spindelzellen, d. h. Lympho-
zyten (grosse, mittelgrosse und kleine), Granulozyten (eosinophile, bichromatophile und basophile),
Histiozyten und Monozyten. Der Prozentsatz der verschiedenen Zellen der Lymphe ist im Tafel
geschrieben. Er ist nach der Jahreszeit verschieden.   Sh. Suzuki.

**239. Studien über das Verhalten der retikuloendothelialen Systeme der Blut-
und der Lymphgefässysteme gegen die ins Blutgefäss eingeführten Tinte.** (Japänisch.)
I. HAMADA. [Kyoto Ig. Z. Bd. **32** (1935).] — Die in die Vene des Kaninchens eingeführte
Tinte wird von Endothelzellen der Kapillaren von Leber, Milz, Knochenmark, Lunge, Neben-
niere und Niere aufgenommen. Dann werden bei Leber, Lunge, Nebenniere und Niere die
Tintenkörperchen grösstenteils zur Drüsenzellen abgegeben, und sie, die in die Lymphgefässe
übergehen, um in die Lymphdrüsen zu erscheinen, sind sehr gering. Durch wiederholte intra-
venöse Injektionen treten die Tintenkörperchen nur in der Lymphdrüsen aus, welche Leber, Lunge,
Nebenniere und Niere durchströmenden Lymphe aufnehmen. Nach Wiederholung mehrmaligen,
etwa 10 bis 20maligen, Injektionen treten geringe Menge von Tinte endlich in allen Lymphdrüsen
des Körpers. Die Lymphknötchen der Darmwand zeigen erst nach einigemaligen Injektionen
geringe Menge von Tintenkörperchen. Da in die Blutgefässe eingeführte Tintenkörperchen in
die Lymphe schwer übergänglich sind, ist es schwer, die zur Lymphgefässystem gehörende reti-
kuloendothelialen Systeme, wie Lymphdrüsen und lymphatischen Gewebe der Darmwand, mit dieser
Methode die Tintenkörperchen aufnehmen zu lassen.   Sh. Suzuki.

**240. Studien über den feineren Bau der Ependymzellen. I. Mitteilung. Über
die Mitochondrien.** S. HANAFUSA. [Nihon Byori. K., **25** (1935).] — Verf. hat die Mito-
chondrien in den Ependymzellen der einzelnen Hirnventrikel des Kaninchens von Anfangs-
stadium der Embryonalzeit an bis zum senilen Alter gefärbt, und folgende Ergebnisse bekommen:
In den einzelnen Abschnitten der Embryonalzeit sind die Mitochondrien von Ketten feinerer
Kügelchen, Ketten von dünnen Stäbchen, so wie die dünner und dicker Stäbchen in grösseren
Mengen vorhanden, wozu eine geringere Menge solcher von der Form feinerer und grösserer
Kügelchen beigemengt ist. Die Mitochondrien zeigen sich im Protoplasma fast gleichmässig
verteilt. Die letzte Tatsache findet sich niemals in allen anderen Perioden ausser Embryonalzeit.
Nach der unmittelbar auf die Geburt folgenden Zeit ordnen sich im allgemein entweder supra-
nukleär, oder basal, oder perinukleär bzw. dicht unterhalb der freien Oberfläche an. Nach Ablauf

des jugendlichen Alters neigen die Mitochondrien zur Gruppenanordnung in supranukleäre und basaler, in geringerer Menge aber in perinukleärer Lage. Die Formen der Mitochondrien der Ependymzellen der einzelnen Hirnventrikel sind durch alle Entwickelungsperiode hindurch nicht langfädig, wie es bei der Leber und Niere der Fall ist; und zwar sind die Mengen der Mitochondrien im Vergleich mit denjenigen der Leber und Niere erheblich geringer an Zahl.

<div align="right">Sh. Suzuki.</div>

241. Chromosome Pairing in *Melanopolus femur rubrum*. E. M. Hearne and C. L. Huskins. [Cytologia 6 (1935).] — Orthopteran material was chosen for the present study, because it has been so variously used by previous workers. Studies of chiasma frequencies, the movement of chiasmata, cytological interference affecting frequency and types of chiasmata, heteromorphic bivalents, and chromosome contraction have been made and are discussed in relation to recent hypotheses. Smear preparations were used for this study, and following results were obtained: The individual chromatids were traced through chiasmata in chromosome configurations during all stages of the first meiotic division in *Melanopolus femur rubrum*. Seventy-one compensating and thirty-five non-compensating chiasmata were found. The chiasma frequencies show interference curves of variation. There is therefore both "chromatid interference" and "chiasma interference" in this species. There is no significant reduction of chiasma frequency in the long chromosomes, and none in the medium and short ones. Interlocked and non-interlocked chromatids occur with equal frequency in the compensating chiasmata. These observations are opposed to Sax's hypothesis of crossing-over; they are in accord with the general "partial chiasmatype" hypothesis, but Belling's formulation of it would require modification to account for the preponderance of compensating chiasmata in this species. Terminal chiasmata are demonstrated to arise from earlier interstitial ones. From both direct observation and the calculation of terminalization coefficients, the movement of chiasmata was found to be toward the spindle attachment in some cases. There in an indirect relationship between chiasma frequency and length of chromosome, and also between length of chromosome and time of terminalization. A heteromorphic bivalent was found in one individual. It has only one chiasma and separates equationally in the first division, as would be expected on the "partial chiasmatype" hypothesis. A greater degree of contraction was found in the chromosomes of the spermatogonial divisions than in the first division of meiosis and the different types of chromosomes contract differencially.

<div align="right">Sh. Suzuki.</div>

242. Über die Beziehungen des zyklischen Auftretens des Fettes in der Uterusschleimhaut zum Ovarialhormon bei weissen Ratten. (Japanisch.) J. HIDAKA. [Nihon Fujinka Gk. Z., 30 (1935).] - Um die Verhältnisse zwischen dem in der Uterusschleimhaut zyklisch auftretende Fett und den Ovarialhormonen klar zu machen, hat der Verfasser experimentelle Untersuchungen bei der Maus ausgeführt, und folgende Resultate bekommen: Das Fett der Uterusschleimhaut von geschlechtsreifer Maus zeigt eine zyklische Veränderung. Es verschwindet im Proliferationsstadium der Schleimhaut (1. u. 2. Stadium), während es im Degenerationsstadium (3. Stadium) wieder auftritt, um weiterin 4. u. 5. Stadien zu gedeihen. Es findet sich meistens im Schleimhautepithel, aber spärlich im Drüsenepithel und auch im Interstitium. Nach der Kastration wird es ganz unabhängig von dem Zyklus immer gefunden. Bei der Injektion des Follikelhormons zeigt die kastrierte Maus ganz gleiche zyklische Veränderung des Schleimhautfettes wie die normale geschlechtsreife. Während der wiederholten Injektionen des Follikelhormons bei der kastrierten Maus erscheint kein Fett in der Schleimhaut und das ist zuerst 3 Tage nach wahrzunehmen. Die Injektion von Corpus luteum-hormon allein zeigt kein Fettveränderung bei der kastrierten Maus, und die Sache ist auch bei der Corpus luteum-hormoninjektion mit der vorangehenden Follikelhormoninjektion ganz gleich. Bei der Corpus luteum-hormoninjektion in der Intervall der wiederholten Follikelhormoninjektionen ist aber das Fett ganz spärlich wahrnehmbar. Das ist nach der Meinung des Verfassers einer Hemmungswirkung des Corpus luteum-hormons gegen Follikelhormon zuzuschreiben. Weiter werden die gleichen Experimente wie die obengenannten bei jungerer Maus mit ganz gleichen Resultaten ausgeführt. Während der wiederholten Follikelhormoninjektionen bei der geschlechtsreifen Maus ist das Schleimhautfett ganz spärlich oder gar nicht wahrnehmbar. Daraus ergeben sich, dass das Fett der Uterusschleimhaut von der Maus mit dem Follikelhormon in einer Beziehung steht, d. h. es bei der Proliferationsperiode als Folge der Follikelhormoneinwirkung verschwinden, während es

bei der Degenerationsperiode, wobei die Follikelhormonwirkung abnimmt, zunimmt, und dass das Corpus luteum-hormon keinen direkten Einfluss auf die Veränderung des Fettes ausübt.

Sh. Suzuki.

243. Über den feineren Bau der Belegzelle der Magenfundusdrüse. I. Spirochaeta im Affenmagen und Belegzellen. (Japanisch.) K. INOUE. [Osaka Igk. Z., 34 (1935).] — Bei der Untersuchung des Affenmagens hat der Verfasser mehrere spiral gewundenen Gebilde in der Lumen der Magenfundusdrüse und sogar in der Belegzellen gefunden. Er hat diese Gebilde nicht anderes als die schon von Bizzozero beschriebenen Spirochaeten gemeint Diese Spirochaeten sammeln sich in den Drüsenlumen, besonders nur an den Belegzellen, um darin hineinzudringen, aber niemals an die oder in den Hauptzellen. Im apikalen Teil der Belegzellen gestalten sie sich ganz gleich wie in den Lumen, aber im basalen werden statt typischen Spirochaeten nur unregelmässig gestaltete Stückchen gesehen, deren Vergleichung mit der normalen granulären Gebilde in den Belegzellen auch genau geschrieben werden. Der Verfasser nimmt der Belegzelle eine etwas nicht aktive, phagozytäre Fähigkeit an. Sh. Suzuki.

244. Über den feineren Bau der Belegzelle der Magenfundusdrüsen. II. Besonders über die sogenannten Korbkapillaren. (Japanisch.) K. INOUE. [Osaka Igk. Z., 34 (1935).] — Um die als der eigentümlicher Bau der Belegzellen wohl bekannte Korbkapillaren oder intrazellulären Sekretkanälchen eingehend zu studieren, hat der Verfasser in der Entwicklungsstadien post partum von Ratte d. h. im Säuglings-, Gemischtessen- und Geschlechtsreifenstadium den feineren Bau der Belegzellen meist durch Eisenhaematoxylin-Färbung zytologisch untersucht, und ist zu folgenden Resultaten gekommen: in den Belegzellen werden drei Zonen unterschieden, wie es schon bekannt ist. Aber die intermediäre Zone ist nach der Meinung vom Verfasser kein ständiges Vorhandensein als intrazelluläre Sekretweg, sondern sie erscheint in den Fällen zuerst, wo die im Zelleib gestauten hellen Sekretvakuolen hier zusammenfliessen. Solche Intermediärzonenbildung ist als ein Charakteristik der Belegzellen zu sehen. Sh. Suzuki.

245. Experimentelle Studien über den sexuellen Zyklus. I. Mitteilung. Morphologische Zusammenhänge zwischen dem sexuellen Zyklus des Ovariums und demjenigen des Uterus beim Kaninchen. (Japanisch.) Sh. INOUYE. [Chosen Igk. Z., 25 (1935).] — Beim Kaninchen zeigen das Ovarium und der Uterus sexuell-zyklischen morphologischen Veränderungen. Unter diesen Veränderungen des Ovariums sind Follikelreifung mit anschliessender Ovulation und Luteinisierung als auffälligste zu betrachten, während Entwicklung der Schleimhautfalten und -Drüsen, Beschaffenheitsveränderungen der Epithelzellen u. a. die wichtigen des Uterus anzunehmen sind. Die Follikelreifung geht in der Regel der Luteinisierung voran, und mit dem Höhepunkt der letzten fällt die Ovulation zeitlich zusammen. Ferner, besteht ein regelmässiges paralleles Verhältnis zwischen Ovarial- u. Uteruszyklus, den der Verfasser tabellarisch folgendermassen angezeigt hat:

Zyklus des Ovariums	Zyklus des Uterus
1. Speicherungsphase der Fettsubstanz (sog. Luteinisierungsperiode)	1. Stadium der Epithelproliferation des Endomertriums u. der Hypertrophie des Myometriums.
2. Höhepunkt der Speicherungsphase (Ovulationstermin) (sog. Blütungsstadium d. Luteinisierung)	2. Höhepunkt der Entwicklung d. Endometriums u. Myometriums.
3. Entspeicherungsphase der Fettsubstanzen	3. Stadium der Alteration des Endometriums u. der Atrophie der Muskelwand (sog. Sekretionsperiode)
4. Höhepunkt der Entspeicherung (sog. Ruhephase)	4. Maximale Gewebsinvolution
5. Phase d. Follikelreife mit schwach ansteigender Luteinisierung	5. Beginn der Epithel- und der Bindegewebszellenvermehrung im Endometrium.

Ausserdem werden histologische Veränderungen des Ovariums und Uterus beim Sexuellzyklus ausführlich beschrieben.

Sh. Suzuki.

246. Experimentelle Studien über den sexuellen Zyklus. II. Mitteilung. Einflüsse des Ovariums und des sexuellen Zyklus auf die Regeneration des Endometriums. (Japanisch.) Sh. INOUYE. [Chosen Igk. Z., 25 (1935).] — Um die Zusammenhänge des Heilungsprozess der am Endometrium vorhandenen Verletzungen mit der Zyklusphasen des Endometriums klar zu machen, hat der Verfasser die Reparations- und Regenerationsvorgänge nach der Auskratzung des Endometriums unter verschiedenen Zyklusphasen und in verschiedenen Intervallen beim Kaninchen untersucht. Bei der Auskratzung in der Speicherungsphase erfolgt die Regeneration des Endometriums prompt und vollständig. Bei der Operation in der Entspeicherungsphase werden die Heilungsvorgänge auffallend verzögert. Bei den vorher beiderseits kastrierten Tieren ist die Regenerationsfähigkeit am geringsten. Die Implantation eines der eigenen Ovarien in die Bauchmuskulatur ist im Sinne der Regenerationsbeförderung erfolgreich, wobei es ziemlich gleichgültig scheint, in welcher Phase sich das transplantierte Ovarium befindet. Aus den oben genannten Resultaten ergibt sich, dass die Regenerationsfähigkeit und Heilungstendenz des verletzten Endometriums je nach dem Zustand des Gewebes im Sinne des sexuellen Zyklus im Moment der Schädigung wesentlich beeinflusst wird. Sh. Suzuki.

247. Experimentelle Studien über den sexuellen Zyklus. III. Mitteilung. Über den Ovulationsmechanismus. (Japanisch.) Sh. INOUYE. [Chosen Igk. Z., 25 (1935).] — Um die Ovulationsmechanismus klar zu machen, hat der Verfasser das Ovarium des Kaninchens in verschiedenen Abständen nach der Kohabitation untersucht. Die Resultate sind etwa folgendermassen: zwischen dem Ovulations- und dem Kohabitationstermin besteht kein gesetzmässiger Zusammenhang. Die Ovulation geschieht am Höhepunkt der Speicherungsphase von Lipoiden im Ovarialgewebe. Dabei ist das letzte zum grössten Teil durch die mit Fettsubstanz beladenen sog. Luteinzellen so ersetzt, dass die Rindensubstanz bis auf eine der Kapsel angrenzende schmale und dünne Zone gedrängt wird, und die in der Reife begriffene Follikel springen auf die Oberfläche stark hervor. Das überziehenden Rinden- und Kapselgewebe werden stärker gedehnt, das faserige Stroma reduziert sich allmählich mit der Zeit und schliesslich berührt die Follikelwand selbst das Deckepithel, damit die Follikel auf der Ovarialoberfläche zum Prolabieren kommen. Das Thecagewebe des Follikels verdünnt sich am der Oberfläche zukehrten Pol, um schliesslich eine ungemein zarte membrandünne Schicht darzustellen. Daran folgen Verschwinden des Deckschichtes, Platzen des Follikels und Entleeren seines Inhaltes. Die von der Zona radiata umgebene Eizelle wird nicht gleich nach dem Platzen des Follikels sozusagen herausgeschleudert, sondern wird erst dann abgestossen, wenn die Platzöffnung eine gewisse Grösse erreicht hat. Die Luteinkörper zeichnen sich durch eine scharfe Abgrenzung gegen die Umgebung und die für sie charakteristische Knotenform aus. Falls sie sich in bzw. dicht neben der Rindensubstanz befinden, prolabieren sie im weiteren Verlauf ihrer Entwicklung auf die Ovarialoberfläche, um dann in der Entspeicherungsphase wieder ins Innere des Ovarialgewebe zurückzutreten. Aus den angeführten Tatsachen zieht der Verfasser folgende Schlüsse: die Luteinisierung bedingt infolge der Lipoidspeicherung eine Volumszunahme des Ovarialmarkgewebes und dadurch wird das Rindengewebe einschliesslich der reifen und unreifen Follikel gegen das Kapsel gedrückt, wobei die in der Reife begriffenen Follikel wegen des Platzmangels oberflächlichenwärts ausweichen müssen. Inzwischen werden Rinden-Kapsel- und Follikelthecagewebe bis zur lokalen Zerreissung überdehnt, welcher sich die Entleerung des Inhaltes, nämlich die der Eizelle anschliesst. Also ist der Ovulationsmechanismus den rein histophysikalischen Vorgängen zuzureichen. Sh. Suzuki.

248. Über die Struktureinheit (Zentralvenen- und Pfortadereinheit) der Vertebratenleber. (Japanisch.) K. ITO. [Ig. Kenkyû 9 (1935).] — Im allgemeinen stellen sich bei den Säugetierlebern die Zentralveneneinheit als Struktureinheit dar, unter der zwei Formen zu teilen sind: Einfache Form, d. h. einfaches Läppchen mit einer Zentralvene und zusammengesetzte Form, d. h. ein zusammengesetztes aus der oben erwähnten „einfache Form ". Ein äusserlich einfaches Läppchen mit verzweigten Zentralvenen gehört zur ersten. Bei Nichtsäugern ist die Läppchenbildung nicht so klar wahrzunehmen wie bei Säugern, mit der Ausnahme bei einer Meerbrassenart. In der oberflächlichen Schicht der Hausrattenleber ist die von Bindegewebe scharf begrenzten Pfortadereinheit zu konstatieren, welche auch bei anderen Säugetieren (Kaninchen, Rind, Pferd) in glücklichen Fällen nur andeutungsweise klar gemacht wird. Die Pfortadereinheit ist nicht anders als die Gesamtheit einer Pfortaderästelung. Die Masschen der Kapillarnetze im Säugetierleberläppchen zeigt sich in der Peripherie rundlich-polygonal und in

der Umgebung der Zentralvene länglichradiär, während sie bei Nichtsäugernleber nur rundlich-polygonol sind: Ausserdem werden stellenweise die strahlenförmig angeordneten Kapillaren in der Nähe von grösseren Gefässen gefunden. In den Fischenleber begleiten die kleinen Gallen-gänge die Pfortaderäste nicht. Sh. Suzuki.

249. Über die Einfluss von verschiedenen pH auf die Vitalfärbung. (Unter-suchungen im Harnweg von Maus). (Japanisch.) T. KAZIMURA. [Osaka Igk. Z., **34** (1935).] — Der Verfasser untersuchte im Harnwege vom erwachsenen Maus den Einfluss von verschiedenen pH auf die Vitalfärbung und kamen zu folgenden Resultaten: Der Vitalfarbstoff wird auf allen Fällen der Untersuchungen von den Epithelzellen des Harnleiters und der Harnblase niemals aufgenommen, aber von den Zellen der Submukosa, des intermuskulären Bindegewebe und der serösen Schicht der oben genannten Organe immer. Und in diesen Schichten nimmt die Farbstoffaufnahme mit der Steigerung von pH immer mehr zu. Daraus scheint die Vital-färbbarkeit des Harnwegsystems in einer gewissen Grenze von den physikalischen Bedingungen abhängig. Sh. Suzuki.

250. Crossing-over in Male of *Drosophila virilis*. H. KIKKAWA. [Cytologia **6** (1935).] — It has long been believed that no crossing-over occurs in the male of *Drosophila* not only between the X and Y chromosomes but also between the homologous autosomes. The few exceptional cases were reported by some authorities. Upon the suggesion of this point, the problem of crossing-over in the male was studied experimentally. It was substantiated that crossing-over does actually occur in the male of *D. virilis*, though the frequency is very low, in the normal state. Sh. Suzuki.

251. Contribution to the Knowledge of Non-disjunction of the Sex Chromosomes in *Drosophila virilis*. H. KIKKAWA. [Cytologia **6** (1935).] — This work was originally undertaken to see the mode of reduction to the heterochromosomes in the germ cell nucleus, which contains some extra sex-chromosomes, and obtained following results: — By using the bob-bed gene of *virilis* which behaves similarly to that of other *Drosophila* species, the mode of reduction of the heterochromosomes has been studied. In the XXY female, the X and XY eggs are not produced in equal number, the ratio of X to XY being about 1.3 to 1. The fact is ex-plained to be due to the elimination of the Y in the meiotic divisions. The frequency of secon-dary non-disjunction in this species is only 0.48%. In the XYY male, the ratio of (XY+Y) to (X+XY) is 3.8 to 1, instead of 2.2 to 1 in *D. melanogaster*. In the XXYY female, the reduction division takes place chiefly according to the type like XY-XY, but the division of the type XXY-Y was found very rarely. In the XYYY male, the division takes place according to the type like XY-YY, but the division of the type X-YYY was found once. Comparing the above results obtained in *D. virilis* with those known in *D. melanogaster*, the following two relations were established; (a) in both species, the frequency of heterosynapsis in the female is lower than in the male, and (b) in both sexes, the frequency of heterosynapsis in *D. virilis* is lower than in *D. melanogaster*. In order to explain these two relations, various possibilities were considered. Of them all the most plausible is the assumption which was based on the differential affinity of homologous chromosomes seen between the sexes and between the species. Sh. Suzuki.

252. Die Lymphbahnen des Oesophagus und der Cardia des Hundes, besonders über ihre regionären Lymphdrüsen. (Japanisch.) S. KISHI. [Arch. jap. Chir., **12** (1935).] — Als die regionären Lymphdrüsen für die oberen Hälfte des Halsteiles von der Speiseröhre sind Lgll. retropharyngea medialis, cervicales craniales, cervicalis media, mediastinalis cranialis anzugeben, während als die für die unteren Hälfte Lgll. cervicalis caudalis, mediastinalis cranialis und bifurcationis genannt werden. Ausserdem fliessen die Lymphgefässe aus den oben erwähnten Teilen direkt, via keine Lymphdrüsen in den Ductus thoracicus ein. Die Lymphgefässe aus dem Brustteil oberhalb der Bifurcation münden sich in die Lgll. mediastinalis cranialis und bifurcationis ein, indem gehen die unterhalb der Bifurcation bald aufsteigend in die Lgll. mediastinalis cranialis und bifurcationis, bald absteigend entlang der Wand der Speiseröhre in die Lgll. lienalis portarum sinistrum und gastrica. Aber ausnahmsweise kann sie direkt den Ductus thoracicus erreichen. Die regionären Lymphdrüsen des Abdominalteiles der Speiseröhre sind in der Regel gemeinsam

mit die des unteren Brustteiles. Die Lymphe aus der Cardia steigt niemals auf, sondern mischt sich mit der absteigenden aus dem unteren Oesophagusteil. Die Lymphkapillaren in der Cardia-schleimhaut kommunizieren mit der vom Oesophagus.   Sh. Suzuki.

253. Über den Wirkungsmechanismus der Strahlentherapie. I. Studien über den Wirkungsmechanismus der Strahlentherapie mittelst Gewebskultur. (Japanisch.) Y. KOMINAMI. [Kinki Fujinka Z., 18 (1935).] — Verf. hat den Einfluss des Röntgenstrahlens auf das in vitro kultivierte Milz des Hühnerembryos untersucht. Direkt nach der Impfung wurde der Flächenraum des Gewebes mit dem Eddinger's Vertikalen Projektionsapparate gemessen; dann wurde in 1 Stunde das Gewebe von Röntgenstrahlen bestrahlt und 1-2 Stunden danach mit eigener Methode des Verfs. fixiert. Was die Zählung der Zellen anbetrifft, hat Verf. eine neue Methode ausgedacht und ist hier daran eigehend beschrieben. Die Ergebnisse sind folgende: Das weiche Strahlen (600 r) hat fast keinen Einfluss auf das Wachstum des kultivierten Gewebes. Auch zeigt das Gewebe durch Bestrahlung von hartem Strahlen wenig bemerkenswerte Veränderung. Also hat das Röntgenstrahlen, in therapeutischer Menge, wenige Wirkung gegen das Wachstum des kultivierten Gewebes. Aber, wenn man, bei der Bestrahlung, anstatt des Glasobjektträgers ein Bleiobjektträger mit einer Grube anwendet, so erscheint die auffallende Hemmung des Wachstums des Gewebes. Diese Erscheinung soll zur Wirkung des sekundären Strahlens und zwar des Elektronenstrahlens zurückzuführen sein.   Sh. Suzuki.

254. Die Differenzierung des skelettogenen Mesenchymus beim Hühnerembryo in vitro. O. V. KRASSOWSKAJA. [Cytologia 6 (1935).] — Die vorliegenden Arbeit behandelt ein Teilthema aus der Frage nach den Zellveränderungen, die im Gefolge der individuellen Entwicklung des Organismus auftreten. Als Objekt der Untersuchung diente das skelettogene Mesenchym einer undifferenzierten Extremitätenknospe von einem 4 Tage im Brutschrank bebrüteten Hühnerembryo. Als Nährmedium diente Hühnerplasma, zur Hälfte mit Tyrode-extrakt aus einem 8-tägigen Hühnerembryo. Dabei tritt eine Differenzierung des skelettogenen Mesenchyms ein. Das skelettogene Mesenchym stellt ein Syncytium dar. Die oxyphile Interzellarsubstanz wird durch Syncresis vom Protoplasma derjenigen Zellen ausgeschieden, die im Syncytium neu entstehen. Bei Änderung des Kolloidzustandes des Ektoplasmas in den Vorknorpelzellen entsteht in ihm eine feine Granulation, die mit Thionin metachromatisch lila gefärbt wird. Aus dem Ektoplasma tritt die Granulation in den Interzellularraum über, wo sie für den Aufbau der Grundsubstanz dient. Die basophile Knorpelgrundsubstanz ist anfangs feinkörnig und wird durch Gelbildung homogenisiert. Die Kapsel der Knorpelzelle stellt das veränderte Ektoplasma der Vorknorpelzelle dar. Die Bildung der basophilen Grundsubstanz geht gleichzeitig mit der Kapselbildung der Knorpelzellen vor sich. Die Differenzierung des skelettogenen Mesenchyms führt in ihrem Ergebnis zur Entstehung von hyalinem Knorpel, der mit Perichondrium bedeckt ist. Wird skelettogenes Mesenchym isoliert von den indifferenten Mesenchymzellen gezüchtet, so kommt es zu keiner Entstehung des Perichondriums, und das Stückchen degeneriert.   Sh. Suzuki.

255. Über meine eigene Methode der Ovarialtransplantation in die Augenvorderkammer bei Mäusen und die Beziehungen zwischen Follikelwachstum und den Befunden der Scheidensekrete nach Anwendung dieser Methode. (Japanisch.) Y. KUROTA. [Nihon Fujinka Gk. Z., 30 (1935).]- Um die Beziehungen zwischen dem Follikelwachstum und den Veränderungen der Scheidensekret zu untersuchen, transplantierte der Verfasser ein Stück vom Ovarium der Maus in die vorderen Augenkammer autoplastisch. Im gedeihenden Transplantat sind die intrafollikuläre Blutung, die Corpus Luteum-bildung u. a. wahrnehmbar, die im weiteren Verlauf nach der neueren Follikelbildung immer weiter wiederholt werden. Das macht sehr schwer, das Transplantat genau zu beobachten. Aber, nur ist eine Ausnahme bei der ersten Follikelbildung nach der Transplantation. Die erste Follikelbildung geschieht am 3-7 Tage nach der Transplantation und meistens einige Tage nach der grossen Follikelbildung tritt die Aufregungsperiode der Scheidensekret auf. Zuweilen aber kann sie schon im Kleinfollikelstadium erreicht worden. Der Verfasser meint, dass diese Tatsache darüber eine Erklärung geben kann, dass das Aufregungsbild der Scheidensekret bei Maus viel häufiger vorkommt, trotzdem die Ovulation nur etwa all 20 Tage wiederholt wird.   Sh. Suzuki.

256. Über die Linsennähte des Tigers. Kaduo MATUMOTO. [Keijo Jour. Med., 6

(1935).] — Der Verf. hat die Morphologie der Linsennähte der Tiger (*Felis tigris sondiaca* Fitz und *Felis tigris mongolia* Less.) eingehend beschrieben: Die Linsennähte sind bei den Tigern auch sehr deutlich ausgebildet wie bei anderen Wirbeltieren. Sie bestehen aus drei Strahlen, die sich an der Mitte der vorderen Linsenfläche, etwas nasalwärts abweichend, punktförmig vereinigt, um dort hin umgekehrte Y-förmige Nahtsystem zu bilden. Die Strahlen sind verschieden lang und makroskopisch geradlinig, aber zeigt sich mikroskopisch sehr verschieden, z. B. S-förmig, geschlängert, bogenförmig gegabelt usw. Der Dorsotemporalwinkel, der zwischen dem dorsalen vertikalen und temporalwärts absteigenden Strahlen gebildet ist, ist unter den Nahtwinkeln am grössten, der dorsonasale, zwischen dem dorsalen vertikalen und nasalwärts absteigenden abgeschlossenen am kleinsten, während der zwischen den nasal- und temporalwärts dorsale Strahl bzw. der ventrale stehen an der vorderen bzw. hinteren Linsenfläche nicht senkrecht, sondern ist nach nasal geneigt. Sh. Suzuki.

257. Über die spezifische Vitalfärbung durch der Mischung von Neutralrot und Methylenblau.
(Japanisch.) K. MATUNAGA. [Osaka Igk. Z., 34 (1935).] — Nach der Vitalfärbung durch Injektion der Mischung von Neutralrot und Methylenblau in den M. sartorius des Frosches untersuchte der Verfasser die Nuance der Kerne und des Endoplasmas der quergestreiften Muskel. Die Resultate lauten etwa folgendermassen: aus dem Färbungszustand werden drei Teile in Muskelfasern unterschieden; Rot-, Violett- und Blauteil. Und der erste ist elektrostatisch am grössten, der letzte am kleinsten, während der mittle nimmt eine Mittelstellung ein. Die mit Neutralrot gefärbten Kerne und Polygranula entfärbt sich durch Reduktion nach etwa 30 Minuten und sind nachher mit Methylenblau wieder nicht färbbar. Sh. Suzuki.

258. Experimentelle Untersuchungen über das supravitalen Bild der Erythrozyten von japanischer Wassermolche. I. Supravitalfärbung mit verschiedenen sauren oder alkalischen Farbstoffen.
(Japanisch.) K. MATSUURA. [Osaka Igk. Z., 34 (1935).] — Mit Hilfe der Supravitalfärbung sowohl mit verschiedenen basischen als auch mit sauren Farbstoffen hat der Verfasser die Verhältnisse der Erythrozyten von *Triton* gegen die verschiedenen Farbstoffe untersucht. Die benutzten Farbstoffen sind folgendermassen: Sauere Farbstoffe: Rubin s. (Säurefuchsin), Wasserblau, Ponceau, Anilin Red (Alizarin), Thymolsulfonaphthalein (Thymolblau), Aurantia, Nigrosin, Acidum carminicum, Methylorgane, Anilin Red (Congo), Berlinerblau La, Bordeux, Kongorot, Crysoidin, Scharlachrot, Erythrosin, Pikrocarmin, Haemateinum Lichtgrün, Tropaedin Coo Nr. 1, Benzoazurin, Ammoniakarmin, Orange G, Orcein, Eosin (wasserlöslich), Trypanblau, Indigocarmin und Thymolblau. Basische Farbstoffe: Eosin-methylenblau, Methylenblau, Methyleum Coeruleum Hochst, Anilinbraun, Brilliantcresylblau, Cresylechtviolett, Gentianaviolett, Neutralrot, Thionin, Safranin, Nilblau-sulfat, Toluidinblau, Methygrün, Azur II, Parafuchsin, Methylviolett 5 B, Janusgrün, Crystalviollet, Bismarkbraun, Anilingrün, Fuchsin, Dahlia Jozitnilinviolett, Malachitgrün, Methylengrün, Acridinrot, Pyronin, Jodgrün und Janusblau G. Die Resultate lassen sich etwa folgendermassen zusammenfassen: die Plasmakomponenten der Erythrozyten wurden mit allen basischen Farbstoffen supravital gefärbt, aber mit allen sauren nicht. Die „B-" und die „F-" granula von Yasuzumi, Kasamatsu und Tajima sind mit allen basischen Farbstoffen nachzuweisen, und zwar ist die Netzstruktur im Plasma, wie die Angaben Yasuzumis u. a. vielleicht die Kette der „F"-Granula. Die Zellmembran wurden supravital mit Gentianaviolett, Malachitgrün, Dahlia und Methylviolett 5 B gefärbt. „B"-Granula ist wahrscheinlich die Lipoproteide gehaltenen Wasservakuole. Sh. Suzuki.

259. Histogenetische und zytologische Studien über das Retinalpigmentepithel des Hühnchens, mit besonderer Berücksichtigung der Pigmentgenese.
(Japanisch.) T. MIYAKE. [Acta Soc. Ophthalm. Jap., 39 (1935).] — Um die Bildung der Pigmentkörner des Retinalpigmentepithels vom zytologischen Standpunkte aus klar zu machen, hat der Verfasser die feineren, inneren Strukturen des Zellleibes bei verschiedenen Stadien von Hühnerembryonen untersucht. Die Resultate sind folgendermassen: In frühen Entwicklungsstadien und zwar bis zum dritten Bruttage besteht das Aussenblatt des Augenbechers aus zylindrischen Zellen. Sie haben in sich noch keine Pigmentkörner, sondern nur die meist fadenförmige, im Zellkörper fast gleichmässig verteilten Plastosomen. Nach der Bebrütung von 4-5 Tagen schon die Pigmentkörner in wechselnder Menge je nach den Zellen zu sehen. Und da die verschieden Übergangs-

formen werden zwischen den Plastosomen und den Pigmentkörner gesehen, so schliesst der Verfasser, dass die Plastosomen als Matrix der Pigmentkörner anzusehen sind.   Sh. Suzuki.

260. Über die feinere Struktur des Pigmentepithels. (Japanisch.) T. MIYAKE. [Acta Soc. Ophthalm. Jap., **39** (1935).] — Der Verfasser hat die feineren inneren Strukturen der Pigmentepithelzellen der Retina bei erwachsenen Fröschen und Kröten untersucht. Zur Fixierung wurden sowohl osmiumhaltige (Meves. Altmann usw.) wie osmiumfreie (Luna, Kolster usw.) Flüssigkeiten benutzt und zur Färbung Heidenhainsches Eisen-Hämatoxylin. Die Resultate lauten folgendermassen: die Pigmentepithelzellen haben im Zellleib zwei Arten von Plastosomen: eine ist schwachgefärbte Fäden oder Stäbchen, andere starkgefärbte Gebilde von verschiedenen Formen. Die erste gehen mit verschiedenen Übergangsformen in die Pigmentstäbchen über, die sicher aus plastosomialen Fäden oder Stäbchen abstammen, um sich bei der Belichtung retinalwärts verschieben. Ausser diesen ein andere stabile Pigmentkorner zu betrachten, deren Genese kaum zu erklären sind. Die zweite verschieden gestaltete, starkgefärbte Gebilde befinden sich gewöhnlich im Basalteil des Zellleibes und haben die Neigung, sich zu verschieden grossen Schollen zu sammeln. Die letzt genannten Schollen gehen mit verschiedenen Zwischenformen in die in demselben Teil vorhandenen, starkgefärbten Myeloidkörner über, und daraus scheint es nicht schwer zu schliessen, dass die Myeloidkörner von solchen starkgefarbten Gebilde herstammen. In den Zellen, besonders in dunkelgestellten sind die sog. Randvakuolen sehr viel zu sehen, und wegen ihrer Grösse und des Vorhandenseins der Übergangsformen schliesst der Verfasser dass der Vakuoleninhalt nichts anderes als das Unwandlungsprodukt der Myeloidkörner ist, und weiter vermutet er dass solcher Vakuoleninhalt als intrazelluläres Stadium von Sehpurpur anzusehen sei. Im tangentialen Durchschnitte wird es klar gemacht, dass die sog. Pigmentfortsätze nur eine die Sehzellen umkleidende, dünne protoplasmatische Hülle sind.   Sh. Suzuki.

261. Studien über die sog. argentaffinen Zellen im Pankreas. (Japanisch.) S. MORITA. [Nihon Byori. K., **25** (1935).] — Es ist schon von Autoren nachgewiesen, dass die argentaffinen Zellen in der Verdauungstraktus, besonders in der Darmkanal ein Bauelement ist. Verf. studierte über diese Zellen, mit der vorher vom Verf. veröffentlichten Färbemethode, am Pankreas des Hundes, und bekam folgende Ergebnisse: — Im normalen Falle ist diese Zelle ein Bauelement des Pankreas. Die Form dieser Zelle ist sehr kompliziert und einzeln verschieden. Obwohl man daher die typische Form nicht feststellen kann, so ist sie meistens der Acinuszellen ähnlich, und liegt zwischen den letzteren. Sie findet sich aber nicht in Langerhansschen Inseln. Die Grösse der Zelle ist gleich die der Acinuszelle. Die Basis der Zelle kommt der Basalmembran in Berührung. Das freie Ende der Zelle erreicht zum Teil die Drüsenlumen. Das Kern ist kugelig, blasenartig, chromatinarm und gleichgross wie das der Acinuszelle. Kernkörperchen gibt es ein oder einige. Die argentaffinen Granula sind etwas kleiner als Sekretgranula, und sammeln sich an Basalteil der Zelle. Golgischer Netzapparat erscheint in der Umgebung des Kernes als Lacune. Zur Hungerzeit vermehren sich diese Zellen ein wenig an Zahl, aber zeigen degenerative Erscheinungen. Beim Eiweissfütterung vermehren sich diese Zellen und verdicken. Die Granula vermehren sich auch, und werden argentaffiner. Bei Lanolinfütterung zeigen diese Zellen degenerative Veränderung, und nimmt die Zahl ab. Beim Rindfleischfütterung vermehren und verdicken diese Zellen 1 Stunde nach der Fütterung, nehmen nach 2–4 Stunden ab, und werden atrophisch. 6–10 Stunden nach der Fütterung kehren die Zustände zurück. Obenerwähnte Befunde zeigen, dass diese Zellen äussere Sekretion ausführen, und besonderen Funktion gegen die Verdauung des Eiweisses erhalten. Durch Injektion von Pilocarpin vermehren und verdicken die Zellen. Atropin zeigt „dagegen" ganz umgekehrte Verhältnisse. Trypsin gibt kein Einfluss gegen diese Zellen. Arsenige Säure scheint die Funktion dieser Zelle unterzudrücken. Traubenzucker bringt Vermehrung dieser Zellen vor.   Sh. Suzuki.

262. Genitalzyklus und Fettgehalt in den Epithelzellen der Uterusschleimhaut bei Maus. (Japanisch.) K. NAITO und H. TANAKA. [Nihon Fujink. Gk. Z., **30** (1935).] — Das intrazelluläre Fett des Epithels ist in allen Stadien von Geschlechtszyklus der Maus mit der Ausnahme der Brunst in der Uterusschleimhaut nachzuweisen. Da es bei der kastrierten Maus auch nachgewiesen ist, scheint es vom Vorhanden des Ovariums ganz unabhängig. Bei der durch der Follikelhormon-injektion horrvegerufenen Brunst der kastrierten Maus verschwindet es, um

nach der Brunst wieder zu erscheinen. Es ist bei der jungen Maus auch sehr reichlich vorhanden wie bei der geschlechtreifen, aber bei der kastrierten und bei der Brunst als Folge der Injektion von Follikelhormon verschwindet es meistens ganz unregelmässig, während die Scheidensekret dabei das vollkommene Brunstbild zeigt. Die Epithelzellen der Uterusschleimhaut der jungen Maus scheint wenig empfindlich gegen Follikelhormoninjektion als die der Scheidenschleimhaut. Aber falls der an der Schwangerenurininjektion folgenden Brunst wird das gleichmässige Verschwinden des intrazellulären Fettes der Uterusschleimhaut von der jungen Maus auch konstatiert. Daraus scheint, dass sich die Epithelzellen des Uterus der jungen Maus ebenfalls gegen eigenen Follikelhormon ganz gleich verhalten wie bei der geschlechtsreifen. Weiter ist das Verschwinden des Fettes bei der Brunst als Folge der Eosin-injektion zu betrachten. Daraus ergibt sich, dass die Veränderungen des intrazellulären Fettes im Uterinschleimhautepithel mit der Proliferation des Epithels in engerem Zusammenhang stehen.   Sh. Suzuki.

263. Studien über die Kultschitzkyschen Zellen des Wurmfortsatzes. II. Experimentelle Untersuchungen über die K.-zellen des Wurmfortsatzes des Kaninchens.
(Japanisch.) Shiro NAKAIGAWA. [Tohoku Ig. Z., Bd. 18 (1935).] — Der Verfasser hat die K-zellen des Kaninchenwurmfortsatzes experimentell untersucht und folgende Schlüsse bekommen: man kann unter den K-zellen des Kaninchenwurmfortsatzes zwei Typen unterscheiden: ein kolbenartiger und der andere spindelförmige. Der erste liegt meist in Krypten, der letzte hauptsächlich im oberflächlichen Schleimhautteil. Und zwischen beiden Typen werden natürlich mehrere Übergangsformen gefunden. Die Verteilung dieser Zellen ist sowohl individuell wie auch regionär sehr verschieden: im Wurzelteil des Wurmfortsatzes sind sie reichlich, im mittelen und distalen Teil viel weniger vorhanden. Die K-zellen sind nicht wanderfähig und werden von Insulin-, Adrenalin-, Glucogenangaben und Hungerlassen morphologisch und quantitativ auch gar nicht beeinflusst. Aus diesen morphologischen und experimentellen Resultaten verneint der Verfasser die innere Sekretionstheorie Erös u. Kahlaus, und vermutet mehr die äussere Sekretion. Weiter nach ihm soll die sog. argentaffine Zellen im Stroma des Wurmfortsatzes zu histiozytären Elementen gehören.   Sh. Suzuki.

264. Studien über die weibliche Geschlechtsorgane des jungen Kaninchens. I.
(Japanisch.) N. NAKAMURA. [Osaka Igk. Z., 34 (1935).] — Die Verfasserin hat bei Kaninchen von 600 gr, 800 gr, 1000 gr und 1200 gr Körpergewicht nach einseitiger Kastration 1% menschliche Placentalextrakt injiziert, um die Veränderungen des zurückgebliebenen Ovariums und Uterus zu untersuchen. Die Resultate lauten folgendermassen: bei Kaninchen von 600 gr wird nur die Hypertrophie der Follikel nach der Injektion gesehen, aber keine Corpus luteum-bildung, die zuerst bei Tieren von 800 gr und darüber in wenigen Fällen geschieht. Die Fällenzahl nimmt mit der Steigerung des Körpergewichtes parallel zu. Weiter zeigen histologische Untersuchungen des zurückgebliebenen Ovariums den Paralellismus der Entwicklung der Follikel mit der der interstituellen Drüsen einerseits, und mit dem Steigen des Körpergewichts anderseits. Die histologische Bilder des Uterus gehen ganz parallel mit den Veränderungen des Ovariums; d. h. die Dickenzunahme der ganzen Uterusschicht bei der Follikelentwicklung und die Vorschwangerschaftsveränderungen der Uterusschleimhaut bei Corpus luteum-bildung.   Sh. Suzuki.

265. Studien über die weiblichen Geschlechtsorgane des jungen Kaninchens. II.
(Japanisch.) N. NAKAMURA. [Osaka Igk. Z., 34 (1935).] — Um die Verschiedenheit der Wirkung von der Placentalsubstanz auf den Uterus der kastrierten Tiere vom verschiedenen Alter zu prüfen, hat die Verfasserin die Placentalextrakt den kastrierten weiblichen Kaninchen vom verschieden Körpergewicht (600, 800, 1000, 1200, 1500 und 2000 gr) 5 Tage lang, täglich 1 mal injiziert und am 6. Tage sind die Tiere getötet werden. Die makroskopischen und auch mikroskopischen Untersuchungen des Uterus dieser Tiere kamen zu folgenden Resultaten: Nach dem Uterusbefund sind die Kaninchen von Körpergewicht 600-10000 gr noch jung zu sehen, indem die von 1200-2000 gr schon geschlechtsreif. Der Uterus der kastrierten jungen Tiere hypertrophiert nach der Injektion des Placentalextraktes sowohl makroskopisch wie mikroskopisch im Vergleich mit dem der Kontrolltiere. Aber die Sache ist bei kastrierten geschlechtsreifen ganz umgekehrt. Das beruht vielleicht auf dem Vorhandensein der durch die Kastration hervorgerufenen Atrophie. Aber die Uterusmuskulatur der kastrierten, jungen und auch geschlechtsreifen Kaninchen sind nicht nur im Absolutwert sondern auch im Verhältniss mit dem Uterusdurchmesser

viel grösser als die der Kontrolltieren. Und aus den obengenannten ergibt sich, dass das im Placentalextrakt erhaltenen sogenannten „ Hypophysenvorderlappenhormon " im allgemeinen auf der Uterusmuskulatur der kastrierten Tiere hypertiophierend wirkt. Sh. Suzuki.

266. Über das Vorkommen des Glykogens in den Knorpelzellen der Knorpel-knochengrenze der Rattenrippe. (Japanisch.) T. OGINO. [Nihon Byori. K., 25 (1935).] — Um die Hypothese von Prof. T. Kimura zu versichern, dass das Glykogen der Zellen in Funktions- oder Reproduktionsphase abnehme und in Ernährungsphase dagegen zunehme, hat Verf. an Knorpelknochengrenze der Rattenrippe, worin die enchondrale Ossifikation stattfinden, Zustand des Auftretens des Glykogens mikrochemisch untersucht. Das Glykogen in der Knorpelknochen-grenze tritt an still stehender Schicht am reichlichsten, an Reproduktionsschicht am geringsten und an der Schicht der reserven Kalkablagerung mittelgradig auf. Und die Glykogeninfiltration beim letzten Falle zeigt degenerative Veränderung der Zellen. Sh. Suzuki.

267. Über den Einfluss der Injektion vom Schilddrüsenextrakte auf den feineren Bau der Schilddrüse. (Japanisch.) K. OKADA. [Osaka Igk. Z., 34 (1935).] · Um den Einfluss vom Hyperthyreoidismus auf den feineren Bau der eigenen Schilddrüse klar zu machen, hat der Verfasser den feineren Bau, besonders den Golgischen Apparat der eigenen Schilddrüse nach der Injektion histologisch untersucht. Die Resultate sind etwa folgendermassen: auffallend sind die Erweiterung der Follikellumen und die Stauung der Colloidmasse. Die Follikelepithel werden niedriger, kubisch und sogar ganz platt. Der Zellleib scheint allmählich dunkler, und schon gleich nach der Injektion sind die Zellen mit starken Colloidreaktion sichtbar, um zu sich sehr schnell vermehren. Danach werden die Haupt- und Colloidzellen unter Follikelzellen unterschie-den, die erstere sind doch der funktionelle, die letzte der ruhe Zustand derselben Zellen. Der Golgischer Apparat, der immer nachweisbar ist, zeigt sich atrophiert und einfacher als beim Ge-sunden, und versammelt sich allmählich neben dem Kerne zur schwarzen Masse. Die obenge-nannten Veränderungen erreicht am 20 30. Tage nach der Injektion den höchsten Punkt.
Sh. Suzuki.

268. Über den feineren Bau der Panethschen Zellen von Affen. (Japanisch.) M. OKUDA. [Osaka Igk. Z., 34 (1935).] — Der Verfasser hat die intrazellulären Element d.h. Plastosomen, Granulen, Vakuolen und Golgischen Apparat der Panethschen Zellen vom Affen-duodenum untersucht und ist zu folgenden Resultaten angekommen: Die der Panethschen Zellen eigentümlichen, groben Granulen können an Grösse und Färbbarkeit sehr verschieden sein. Sie stammen aus den Plastosomen und verändern sich endlich zu unfärbbaren Vakuolen, wie es schon von Takagi, Murakami u. a. angegeben sind. Und da der Golgischer Apparat dieser Zellen mit den groben Körnchen parallel gedehnt, so behauptet der Verfasser, dass sie sich bei der Granula-bildung, d. h. an dem Sekretionsprozess nicht passiv, sondern aktiv beteiligt wie die Plastosomen, trotzdem die letzten dabei natürlich viel wichtigere Rolle spielen. Sh. Suzuki.

269. Über den Golgischen Apparat von Langerhansschen Inselzellen von schwan-gerer Maus. (Japanisch.) M. OKUDA und T. SAWADA. [Osaka Igk. Z., 34 (1935).] — Durch den ganzen Schwangerschaftsverlauf kann man unter Inselzellen sog. helle und dunkle Zellen unterscheiden. Die hellen Zellen scheinen am Anfangsstadium der Schwangerschaft fast normal, aber hypertrophieren im mittleren, um ins Endstadium von der Schwangerschaft und gleich nach der Geburt wieder allmählich zurückzubilden. Die dunklen Zellen scheinen anfangs fast normal, aber beim weiteren Verlauf der Schwangerschaft vergrossern sie sich. Ihrer Golgische Apparat nimmt seine Grösse zu und kompliziert am Bau, und das ist am Endstadium am deut-lichsten. Weiter die Verfasser vom Vorhandensein des Parallelismus zwischen Funktions-zustand der Inselzellen und Form des Golgischen Apparates in ihnen vermuten, dass Golgischer Apparat kein Matrix des Sekretes ist, sondern dass er auf die Sekretbildung befördernd einwirkt.
Sh. Suzuki.

270. Über die Klassifikation der Leukozyten von Reptilien und Fischen. (Japanisch.) T. ONODA. [Nihon Byori. K. 25, 1935.] — Verf. versuchte die Klassifikation der Leukozyten der Reptilien und Fischen an Schildkröte, Schlange, Eidechse, Karausche, Karpfen und Schmerle, sowohl in der Wachzeit als auch in der Schlafzeit. Die Leukozyten der Reptilien unterscheiden

sich in 4 Arten von Granulozyten d. h. pseudoeosinophile, bichromatophile, basophile und eosino-
phile Leukozyten, und 2 Arten von mononukläre Leukozyten d. h. Lymphozyten und grosse
Monozyten, und noch ferner Pigmentzellen vorhanden. Bei Fischen gibt es bichromatophile, basophile
sehr selten) und eosinophile Granulozyten, Lymphozyten und grosse Monozyten. Was der Zahl
der Leukozyten anbetrifft, so ist sie bei Reptilien etwa 28000–36000, und bei Fischen 32000–
36000. Ferner hat Verf. die Migrationsgeschwindigkeit der Leukozyten gemessen.

<div align="right">Sh. Suzuki.</div>

271. On the Chromosome Morphology of Certain Amphibia. A. PROKOFIEVA.

[Cytologia 6 (1935).] — The problem to be solved in this investigation has been considered
the elucidation of the nature of the V-shaped chromosomes of Amphibia, *Triton taeniatus*, *Axolotl*
and *Rana temporaria* serving as material for the purpose. A mixture of 50% formalin with 5%
chromic acid at a ratio of 8:2 (for *Triton taeniatus* and *Rana temporaria* chromosomes), as well
as a mixture of 10% formalin with 1% chromic acid at a ratio of 7:3 (for *Axolotl* chromosomes)
have proved to be the best fixatives for exposing the structure of chromosomes of the investigated
species. The chromosomes of the species have shown their structure consisting of two arms
jointed by a median or submedian constriction and proving to be strictly constant for each
chromosome, owing to which it has been possible to suggest a preliminary grouping of chromo-
somes for each species. The structure of the chromosomes differs in different chromosomes.
They may assume the shape either of a long, thin, achromatic fibre joining both the arms
together or that of an achromatic break, or that of strongly marked structure in the chromosome
body. It seemes quite probable that the chromosome constriction in animals, identical to that
in plants, represents the basis to the morphological structure of chromosomes and gives these a
difinite external organization. The discovery of constrictions in animal chromosomes is apparently
a question of technique.

<div align="right">Sh. Suzuki.</div>

272. The Stucture of the Chromocenter. A. A. PROKOFYEVA-BELGOVSKAYA.

[Cytologia 6 (1935).] — The chromosomes in the nuclei of the salivary gland cells of *Drosophila
melanogaster* are connected at their proximal ends by means of the conjugation of the genes
in the inert region of the X chromosome and the Y with those in the proximal regions of the
autosomes, and of those in the proximal regions of the different autosomes with one another.
This would indicate some sort of homology between these regions in all the chromosomes, a
homology, moreover, extending not merely to a single gene, but also to a whole linear lot of genes.
It would also follow that the arrangement of these homologous genes in the proximal portions
of the different chromosomes is similar. But if nonhomologous loci in the region can conjugate,
as in maize, these inferences would not follow. They represent only preliminary steps in a
series of cytological and genetic studies, the way to which has just been opened up. In this
connection the suggestion may be recalled that the spindle-fibre regions not only of the X and
Y but also of the autosomes may be homologous with one another and of the nature of " inert
regions", and that by the translocation of these regions both increases and decreases of chromo-
some number may have occurred in past evolution.

<div align="right">Sh. Suzuki.</div>

273. Rôle du noyau l'élaboration du sécret. par la glande séricigène. P. RE-

VUTZKAJA. [Cytologia 6 (1935).] — Verf studierte die Beziehungen zwischen der morphologischen
Eigenschaften der Kerne der Seidendrüsenzellen des Seidenwurms und der Sekretion der Seide,
d. h. die Beziehungen zwischen der Form der Kerne und die Funktion der Zellen. Die Beobach-
tungen beziehen sich auf folgenden Sachen:— 1. Der zikrische Charakter der Transformation in
der Form der Drüsenkerne. 2. Die Vereinstimmung der Form der verästerten und nicht
verästerten Kerne mit der Intenzität der Vollendung der Sekret. 3. Die Bildung irgendeines
Herstellers der Prosekret im Kerne. 4. Die Beziehung zwischen dem Verbrauch des Chromatins
und der Sekretion der Zelle. 5. Das Vorhandensein eines Nucleolus, das Chromatin enthält,
in der Kerne. 6. Die Unmöglichkeit, alle Prozesse der Sekretion aus der „pyrénolyse" auszuführen.

<div align="right">Sh. Suzuki.</div>

274. Experimentelle Untersuchungen über die männliche Geschlechtsdrüse. VII.
Über den Einfluss der Injektion des sog. Hypophysenvorderlappenhormons nach der
Exstirpation der Zirbeldrüse auf die männliche Geschlechtsdruse. (Japanisch.) Taro

SAKURANE. [Osaka Igk. Z., **34** (1935).] — Die Fragestellung dieses Experimentes ist folgendermassen: 1) ob die Zirbeldrüse auf die Geschlechtsdrüse hemmend einwirkt, 2) warum der Widerstand gegen die Einwirkung des Hypophysenvorderlappenhormons bei der männlichen Geschlechtsdrüse grösser als bei der weiblichen. Um diese Fragen klar zu machen, hat der Verfasser den die Zirbeldrüse operativ weggenommenen Kaninchen kleine Menge vom Schwangerenharn wiederholt (4–5 cc 7 beim Männchen, 2 cc 5 beim Weibchen) injiziert und folgende Resultate erreicht: Die Exstirpation der Zirbeldrüse befördert bei geschlechtsreifen Männchen die Einwirkung des Hypophysenvorderlappenhormons auf die Geschlechtsdrüse, während bei geschlechtsreifen Weibchen gar nicht. Dasselbe Verfahren scheint bei jüngeren Männchen etwas zu befördern, bei jüngeren Weibchen fast nicht. Die Zirbeldrüse reguliert die durch die Injektion des sog. Hypophysenvorderlappenhormons hervorgerufene Frühreife der männlichen Geschlechtsdrüse hemmend, aber sie beeinflusst die der weiblichen gar nicht. Die Einwirkung der sog. Hypophysenvorderlappenhormons nach der Exstirpation der Zirbeldrüse ist im Hodenparenchym am auffallendesten. Weiter, als Anhang wird die Exstirpationsmethode der Zirbeldrüse genau beschrieben. Sh. Suzuki.

275. Über die Beziehung zwischen der Kulturtemperatur und dem Wachstum der Irisepithelkulturen vom Huhnerembryo. (Japanisch.) K. SANJO. [Acta Soc. Ophthalm. Jap., **39** (1935). Festschr. Prof. Suganuma.] — Die Verfasserin hat das Irisepithel vom 8 Tage alten Hühnerembryo in 36°C, 39°C und 42°C, oder im Bereiche von 39°C–45°C mehrere Passage hindurchgezüchtet, um das Wachstum und morphologisches Bild zu untersuchen. Die Hauptresultate lauten folgendermassen: Das Irisgewebe gewöhnt sich mehr oder weniger an höhere Temperatur, seine Wiederstandfähigkeit ist bei niedriger Temperatur grösser als bei hoher. Beim Stehenlassen in niedriger Temperatur sind keine histologische Veränderungen des Irisgewebes zu beobachten, indem bemerkenswerte Veränderungen in hoher Temperatur. Sh. Suzuki.

276. Notes on the Mitotic Behavior of Long Chromosomes. F. SCHRADER. [Cytologia **6** (1935).] — A test is provided by those hemipteran chromosomes that are exceptionally long, even during meiosis. An outstanding example is the unpaired X chromosome of the male of *Protenor belfragei*. The type of mitotic movement as seen in the X of *Protenor* is radically different in the two spermatocyte divisions, and differs from that of correspondingly long chromosomes of Amphibia. In the equation division, the entire broadside of the X serves as a base for the halfspindle component. In the reduction division the X is connected with both poles through a single delicate fibre. The nature of the interzonal connections in the case of long chromosomes is discussed. Sh. Suzuki.

277. Studien über die Kernverschiebung und Migrationsgeschwindigkeit der Vertebratenleukozyten, gesehen auf dem Standpunkt der Phylogenie. (Japanisch.) S. SUGIYAMA und T. ONODA. [Nihon Byôri. K. **25** (1935).] — Verff. ausführten eingehende Studien an 13 Arten von Mammalien, 16 Arten von Vögeln, 5 Arten von Reptilien und 4 Arten von Amphibien. Die Temperatur bei der Messung war bei Warmblütern 37°C und bei Kaltblütern Zimmertemperatur (15–28°C). Die Ergebnisse waren folgende: Verschiedene Leukozytenarten der Vertebrate haben je eigentliche Migrationsgeschwindigkeit, und die der neutrophiler, pseudoeosinophiler und bichromatophiler Leukozyten sind am grössten, die der eosinophiler Leukozyten folgt ihnen und die der grosse mononukläre Leukozyten und Lymphozyten ein wenig kleiner als die der vorhergehende. Die basophile Leukozyten der Mammalien stehen an Migrationsgeschwindigkeit auf 3. Reihe, und haben grosse Kernzahl. Die der Vögeln und Reptilien stehen auf der niedrigsten Reihe, und haben nur einziges Kern. Nach dieser Tatsache scheinen die basophile Leukozyten die relativ später differenzierten Blutzellen zu sein. Mit Ausnahme der Fischen, ist im allgemeinen die durchschnittliche Migrationsgeschwindigkeit der Granulozyten grösser bei höheren Tieren als bei niederen. Im Gegenteil ist die Geschwindigkeit der Monozyten, unabhängig von der Differenzierungsgrad der Tieren, fast konstant. Die Mittelzahl der Kerne nimmt auch mit der Differenzierungsgrade zu, d. h. ist parallel mit der Migrationsgeschwindigkeit. Aber die Amphibien sind Ausnahme, und haben sehr grosse Kernzahl. Sh. Suzuki

278. Entwicklungsgeschichtliche Untersuchungen über die Kopfganglien von Megalobatrachus japonicus. (Japanisch.) Masaharu SUZUKI. [Chiba Igk. Z., **13**, H. 7. 1935).] — Die Entwicklung der Neuralleiste und der Kopfganglien vom japanischen Riesensalamander wird ausführlich beschrieben: die Neuralleiste stammt bei diesem Tiere als eine selbständige Anlage aus dem Ektoderm, der zwischen der Anlage des Zentralnervensystems und der des Hautektoderms liegt. Sie beteiligt sich zur Bildung sowohl des Kopfmesenchyms (Mesoektoderm) als auch der Ganglienanlage, die letztere vom Verfasser eine Gewebsverdichtung genannt wird, welche eine direkte morphologische Fortsetzung der Neuralleiste darstellt. Eine „indifferentes Stadium" zwischen der Neuralanlage und der Ganglien, dessen Vorhandensein bei einigen Vögeln und Säugetieren von Holmdahl behauptet wird, ist bei diesem Tiere nicht wahrnehmbar. Die Neuralleiste teilt sich bei der Larve von 12 Ursegmenten (Körperlänge 8.7 mm) in drei Abschnitte: die Mesencephalon-, die mittlere und die hintere Rhombencephalonneuralleiste. Aus dem kaudalen Teil der ersten entwickelt sich das Ganglion trigemini, aus der zweiten der Acusticofacialis-komplex und aus der letzten der Glossopharyngovagus-komplex. Ausser den obengenannten Ganglien von der Neuralleistenherkunft entwickeln sich am Kopf des Riesensalamanders die Lateralisganglien, die aus der Plakode des Ektoderms abstammen. Sie sind in zwei Gruppen einzuteilen: die eine besteht aus dem Ganglion laterale VII, die andere aus dem Ganglion laterale X. Weiter werden die Beziehungen zwischen den Kopf- und Lateralisganglien im weiteren Verlauf der Entwicklung eingehend beschrieben. Sh. Suzuki.

279. Über die Entbindung der Vorderextremität am Ende der Metamorphose der Anuren (V). (Japanisch.) Shigetake SUZUKI, Kenjiro KOBAYASHI und Michio NIIJIMA. [Chiba Igk. Z., **13**, Hft. 1 (1935).] — Eine statistische Mitteilung über zeitliche Verhältnisse zwischen der Entbindung der Vorderextremität und der Rückbildung des Schwanzes bei normaler Entwicklung von *Bufo vulgaris japonicus*. Sh. Suzuki.

280. Entwicklung der Kopfganglien und der Vorderkopfsomiten bei den Reptilien. (Japanisch.) Isamu TAKEI. [Chiba Igk. Z., **13**, Hft. 1 (1935).] — Die Untersuchungen werden bei Schildkröte (*Tryonix japonicus*) ausgeführt. Die Neuralleiste wird beim Neuralplattenstadium als eine Zellauswanderung im Zwischengebiet der Hautektoderms und der Neuralplatte angelegt und sie bildet beim Stadium des geschlossenen Neuralrohres den dorsalen Teil des Neuralrohres direkt unterhalb des Hautektoderms. Dann sie segmentiert sich in drei Abschnitten: die vordere, die mittlere Rhombencephalonneuralleiste und die hintere zusammenhängende Neuralleiste. Die erste ist die Matrix der Trigeminusganglien; aus der zweiten stammt die Acusticofacialisganglien ab und aus der letzten die Glossopharyngovagusganglien. Das Neuralleistenmaterial beteiligten sich nicht nur an der Bildung der Nervenanlage, sondern auch im grossen Masse an der des Kopfmesenchyms (Ektomesoderm). Als die Vorstufe der Kopfganglien wird eine Gewebsverdichtung als die direkte Fortsetzung der Neuralleiste angegeben, welche der Verfasser die Nerven- oder Ganglien-anlage nennt. Dann die Entwicklung des N. trigeminus, N. acusticofacialis. N. glossopharyngovagus und die den obengenannten Nerven angehörigen Ganglien wird ausführlich beschrieben. Weiter untersucht der Verfasser die Entwicklung der Vorderkopfsomiten und berücksichtigt noch die Entwicklung der Augenmuskeln und der visceralen Kopfmuskeln. Sh Suzuki.

281. Über die Sekretionsphase der Zellen des Hypophysenvorderlappens. (Japanisch.) T. TANABE. [Nihon Byôri. K., **25** (1935).] — Das Los der Sekretgranula der Zellen des Vorderlappens ist nichts anders als die morphologische Äusserung des Sekretionsmechanismus. Die Sekretionsmechanismus liegt darin, dass das Sekret durch die Verflüssigung der Granula gebildet wird. Die Zustände der Sekretgranula werden in folgenden 6 Phasen geteilt: 1. Stadium der undifferenzierten Granula, 2, Granulabildungsstadium, 3. Ruhestadium, 4. Verflüssigungsstadium, 5. Aktionsstadium und 6. Degenerationsstadium. Jede der drei Zellarten des Vorderlappens zeigt, ohne eigentliche Beschaffenheiten der Granula zu verlieren, eigene Phasenveränderungen. Deshalb kann man monistischen Anschauung über die Herkunft der Zellen des Vorderlappens nicht zustimmen, und die Zellen soll in folgende vier Arten geteilt werden: Hauptzellen (nicht differenzierte chromophobe Zellen), differenzierte chromophobe Zellen, acidophile und basophile Zellen. Sh. Suzuki.

282. Entwicklungsgeschichtliche Untersuchungen des Gehörorgans von japanischer Kröte. II. Über die Entwicklung des knöchernen Labyrinthes. (Japanisch.) A. TAZIMA. [Tokyo Joig. Z., 5 (1935).] — Die erste Anlage der Ohrkapsel ist zuerst in den Larven von ca. 4.5 mm Körperlänge als sog. „periotisches Gewebe" lateral und ventral vom Ohrbläschen gefunden. Das laterale „periotische Gewebe" differenziert etwas früher und beteiligt sich zur Bildung der dorsalen Wand und der Lateralteil der ventralen Wand der Ohrkapsel. Das ventrale bildet dagegen die ventrale Wand der Ohrkapsel und verbindet sich am medialen Ende mit der Basalplatte. Die so gebildete Ohrkapsel zeigt sich etwa pyramidenförmig. Ihre dorsale Wand bildet am frühesten aus, daran folgt ihre ventrale und zuerst gleich vor dem Metamorphosenbeginn ist die Ausbildung der medialen fertig. In der Mitte der ventralen Wand wird die Fenestra ovalis ausgebildet und in der medialen Foramen perilymphaticum. endolymphaticum und acusticum. Unter diesen in der medialen Wand liegenden entwickelt sich der erstere am frühesten und später teilt sich in For. perilymphaticum sup. et inf. Dagegen ist die Entwicklung der zwei anderen sehr langsam. Zuerst gegen den Metamorphosenbeginn differenzieren aus dem letzten For. acustic. ant. et post. durch die Bildung der Knorpelscheidewand, die ausserdem mit der Basalplatte ein ovale Loch, For. acustic. medium bildet. Die Ohrkapselhohle ist anfänglich einheitlich, aber teilt sich mit der Differenzierung von häutigem Labyrinth in drei Cavi semicircularia und ein Cavum commune. Weiter wird die Entwicklung des schalleitenden Apparates, besonders von Operculum und Columella ausführlich beschrieben.   Sh. Suzuki.

283. Entwicklungsgeschichtliche Untersuchungen des Gehörorgans von japanischer Kröte. I. Über die Entwicklung des häutigen Labyrinthes. (Japanisch.) A. TAZIMA. [Tokyo Joig. Z., 5 (1935).] — Die Verfasserin hat die Entwicklung des häutigen Labyrinthes von japanischer Kröte in 5 Stadien (von Neurula bis zum Individuum von 5 6 Monate nach der Metamorphose) ausführlich untersucht. Die Gehörplatte als die erste Anlage des Gehörorgans wird in der Larve von 2.5 mm Körperlänge zuerst gefunden. Das Gehörbläschen wird in der Larve von 4.8 mm K. L. von kranial nach kaudal allmählich geschlossen, und in diesem Stadium differenziert schon die gemeinsame Anlage von Ductus und Saccus endolymphaticus ziemlich deutlich. Die drei Bogengänge beginnen auch in den Larven von 4.8 5 mm K. L. zu differenzieren und werden durch die vollkommenen Durchschnürung der Pars ampullaris und utriculus voneinander selbständig isoliert, die in den Larven von 6 7 mm K. L. meistens geschieht. Weiter wird die Differenzierungsverlauf von Dreibogengängen, Utriculus, Sacculus, Ductus und Saccus endolymphaticus sowie einzelner Teile von obengenannten Organen sehr ausführlich beschrieben.   Sh. Suzuki.

284. Beitrag zur Kenntnis der Entwicklung des Penisknochens, nebst Bemerkungen über ihre Bedeutung. S. TOBINAGA. [Keijo J. of Med. Vol. 6 (1935).] - - Der Verfasser hat die Entwicklung des Penisknochens von *Rattus norvegicus* var. *albus* Fitzinger untersucht. Das Os penis ist bei diesem Tiere immer zu finden und besteht aus zwei Gliedern, einem proximalen, langen Glied, Os penis proprium und einem distalen, kurzen, Os glanis, und zwischen beiden sich ein derber Bindegewebsstrang spannt. Der erste dieses Knochens kommt erst am zweiten postembryonalen Tage in der Tiefe vom Corpus carvernosum als Vorknorpelgewebe zum Vorschein, welches am 6. Tag durch lebhafte Grundsubstanzbildung zum Hyalinknorpel umgebildet wird. Gleich daran folgt die lebhafte Ossifikation dieses Knorpels in enchondraler und auch perichondraler Weise bis zum etwa 25. Tage nach der Geburt. Die Ossifikationspunkt ist an der Mitte des Knorpels nur einzig allein zu beobachten. Der primäre Knochenmark besteht aus den weissen Blutzellen, die sich im weiteren Verlauf der Entwicklung immer vermehren, und vom 14. Tagen an wandelt er sich zum sekunkären Knochenmark um, der an roten Blutzellen sehr reich ist. Am 59. Tage ist er aber aus reichlichen Fettzellen zusamengesetzt. Der Penisknochen ist, nach der Meinung des Verfassers, ein wichtiges Gebilde für das Geschlechtsleben des Tieres. Das Auftreten desselben bedeutet ein Zeichen der Reife des Tieres.   Sh. Suzuki.

285. Noch einmal etwas über die Morphologie und die Entwicklung des Knorpelakzessoriums bei Chiropteren. T. TSUSAKI. [Keijo J. of Med. Vol. 6 (1935).]— Der Verfasser hat die Morphologie und Entwicklung des Knorpelakzessoriums bei den Fledermäusern untersucht. Als Untersuchungsmaterial werden die folgenden Fledermäusern benutzt:

Megachiroptera (*Pteropus pselaphon*), Vespertilionidae (*Pipistrellus abramus, Vesperugo noctula, Plecotus auritus sacrimontis, Miniopterus schrebersii japoniae, Nyctalus aviator, Eptesicus horikawai, Epitesicus velox*), Rhinolophidae (*Hipposideros armiger terasensis, Rhinolophs cornutus cornutus, Rhinolophys ferrum-equinum nippon*). Das Knorpelakzessorium ist von hyaliner Natur und ist immer bei Megachiropterae und Verspertilionidae an der medialen Seite des Endophalanx des fünften Fingers allein zu beobachten, aber fehlt bei Rhinolophys vollständig. Es bleibt zeitlebens immer knorpelig und verknöchert sich niemals. Seine Anlage ist ganz unabhängig von der Anlage der Endphalagenknorpels vom fünften Finger ausgebildet. Nach der Meinung des Verfassers ist das Knorpel akzessorium als Sesambein zu betrachten.   Sh. Suzuki.

286.   Contribution à l'étude de l'ostéologie chez la grue. 1. Étude sur les os du tronc. T. TSUSAKI. [Keijo J. of Med. 6 (1935).] **2. Étude sur les os du membre postérieur.** [Keijo J. of Med. 6, (1935).] **3. Étude sur les os du membre antérieur.** [Keijo J. of Med. **6** (1935).] — Der Verfasser hat das Knochensystem des Kraniches (*Megalornis japonensis*) anatomisch untersucht. In der ersten Mitteilung wird das Knochensystem des Rumpfes, d. h. Wirbelsäule, Sternum und Rippen eingehend beschrieben, in der zweiten das der hinteren Extremität und in der dritten das der vorderen Extremität. Die Beschreibungen sind so ausführlich, dass sie für die kurze Referierung ungeeignet sind.   Sh. Shzuki.

287.   Künstliche Corpus-luteum-bildung bei einseitig kastrierten Tieren. III. Resultate im gleichen Individuum. (Japanisch.) Senzi TUNEOKA. [Osaka Igk. Z. **34** 1935).] — Bei einseitiger Kastration steigert sich die Fähigkeit der Luteinkörperbildung des gebliebenen Eierstockes durch Schwangerenurininjektion und zwar etwas doppelt wie bei Kontrolltieren (Experimenttiere: Kaninchen).   Sh. Suzuki.

288.   Künstliche Corpus-luteum-bildung bei einseitig kastrierten Tieren. IV. Untersuchungen an sehr jungen Tieren. (Japanisch.) Senzi TUNEOKA. [Osaka Igk. Z., **34** (1935).] — Um das Corpus luteum künstlich zu bilden, hat der Verfasser den Harn der Frühschwangeren an jungen Kaninchen von Körpergewicht 1600-1750 gr injiziert, die im voraus im Stadium von Körpergewicht 600 750 gr einseitig kastriert wurden. Dabei ist die Wirkung des im Harn erhaltenen Hypophysenvorderlappenhormons auf die Kastrierten doppelt so stark wie auf die normalen. Gleichzeitig übertrifft das zurückgebliebene Ovarium der Kastrierten das der normalen an Grösse und Gewicht in hohem Grad.   Sh. Suzuki.

289.   Über die Hypertrophie des Kaninchenuterus durch die Injektion verschiedener Geschlechtshormones. (Japanisch.) Senzi TUNEOKA. [Osaka Igk. Z., **34** (1935).]— Die Hypertrophie des Kaninchenuterus, die durch die Injektion vom Harn der frühen Schwangeren hervorgerufen wird, kommt durch die Kastration auf fast normaler Grösse zurück. Und das Hypophysenvorderlappen- und Ovarialhormon wirken gegen diese Rückbildung hemmend.
               Sh. Suzuki.

290.   Über den Einfluss von pH auf die Fixierung der Mastzellen. (Japanisch.) K. YAMADA. [Osaka Igk. Z., **34** (1935).] — Nach der Fixierung der 10% Formalinlösung von verschiedener pH werden die Mastzellen des Rattenmesenteriums mit Toluidinblau gefärbt. Bei der Fixation mit 10% Formol von pH 3.82-3.09 ordnen sich die Mastzellengranulen dicht und ganz regelmässig. Mit der Verschiebung von pH nach sauer Seite allmählich verschwinden. Die Metachromasie-erscheinung ist mit der Aufsteigerung von pH sehr auffallend.
               Sh. Suzuki.

291.   Über die zytoarchitektonische Gliederung des roten Kerns der Maus. Y. YAMAGISHI. [Fol. Anat. Jap., Tôkyô, **13** (1935), 219–229, 1 Taf.] — Der rote Kern der Maus weist wie bei der Katze, dem Hunde, Kaninchen, und Meerschweinchen keinen einheitlichen Bau auf und lässt sich in 4 Haupt- und 2 Nebenkerne einteilen. Er zeigt aber unter den genannten Tieren die einfachste Struktur und besteht nur aus 3 Zellarten, d. h. aus mittelgrossen, kleinen und kleinsten Zellen im Gegensatz zu demjenigen des Meerschweinchens und Kaninchens, bei welchen er aus 5 Zellarten zusammengesetzt ist.   Sh. Suzuki

292. Kausal-analytische Studien über die Befruchtung des Kanincheneies. I. Die Dispersion der Follikelzellen und die Ablösung der Zellen der Corona radiata des Eies durch Spermatozoen. J. YAMANE. [Cytologia 6 (1935).]— Die vorliegende Arbeit bezweckt nun die proteolytische Wirkung der Spermatozoen, die sich in der Dispersion der Follikelzellen und der Ablösung der Zellen der Corona radiata des Eies erweist, eingehend zu ermitteln. Beim Kaninchen wird das Reifei stets in voller Ausrüstung mit Corona radiata und Follikelflüssigkeit in den Eileiter abgestossen. Die Zellen der Corona radiata befinden sich nicht nur untereinander in dichtem Andrang, sondern auch mit der Eifülle (Zona pellucida) in fester Verwachsung. Die Follikelflüssigkeit, die nichts anderes ist als verflüssigte Form der Stratum granulosum, stellt eine äusserst zähe Masse dar, weshalb sie als Follikelzellmasse bezeichnet wird. Weder die Follikelzellmasse noch die Coronazellen lassen sich im frischen Zustand selbst mechanisch nicht leicht vom Ei beseitigen. Dieses Verhalten der Follikelzellmasse und der Coronazellen mit dem unbesamten Ei bleibt eine Zeit lang sowohl im Eileiter als auch in vitro erhalten. Wird das Ei aber entweder durch fertile Kopulation oder durch künstliche Besamung in vitro gefruchtet, so wird es von dieser Ausrüstung vollkommen befreit. Es lässt sich schliessen, dass diese Erscheinung einerseits der physikalischen andererseits der chemischen Wirkung der Spermatozoen auf die Follikelzellmasse und die Coronazellen zurückzuführen ist. Allerdings hat dabei die chemische d. h. proteolytische Wirkung, die die Spermatozoen innebehalten, überwiegende Bedeutung. Dass es sich um eine fermentative Wirkung handelt, wird in den nachfolgenden Arbeiten eingehend erörtert.   Sh. Suzuki.

293. Kausal-analytische Studien über die Befruchtung des Kanincheneies. II. Die Isolierung der auf das Eizytoplasma auflösend wirkenden Substanzen aus den Spermatozoen. J. YAMANE. [Cytologia 6 (1935).] — Die vorliegenden Experimente wurden vorgenommen, um die Follikelzellmasse des Kanincheneies zur Dispersion führenden Substanzen aus den Spermatozoen zu isolieren; ferner um die Reaktionsfähigkeit der Eizelle, der Eihülle und der Coronazellen auf diese Substanzen zu prüfen. Die Ergebnisse sind folgende: Die mit Toluol abgetöteten Spermatozoen können die Follikelzellmasse dispersieren und auf die Corona radiata ablösend wirken ebenso wie die lebhaft bewegenden Spermatozoen. Dies weist shon darauf hin, dass die chemische Wirkung der Spermatozoen hierbei die Hauptrolle spielt. Die Follikelzellmasse zur Dispersion führenden Substanzen lassen sich mit Tyrodelösung ohne weiteres aus den Spermatozoen extrahieren. Sie sind im Samenextrakt in so hoher Konzentration enthalten, dass ihre Wirkungen auf das Ei viel stärker zutagetreten als bei der Besamung mit Spermasuspension. Die Reaktion des Eies auf diese Substanzen offenbaren sich sehr verschiedentlich: Dispersion des Follikelzellmasse, Ablösung der Coronazellen, Auflösung der Eihülle, lebhafte Zytoplasma- und Kernteilung in der unbesamten Eizelle, das Zurücktreten der Eichromosomen von der Peripherie nach dem Zentrum des Zytoplasmas, das Zerfallen des Chromosomenkomplexes usw. Diese Reaktion sind jedoch prinzipiell gleich und lassen sich der Auflösung des Zytoplasmas zurückführen. Die in Frage stehenden Substanzen des Samenextraktes sind beim pH-Wert 7,7 leistungsfähig, wenigstens 6 Tage lang bei 5°C aufbewahrbar; sie werden jedoch durch Kaolien gewissermassen adsorbiert und durch das Kochen vollständig inaktiviert. Diese Eigenschaften deuten darauf an, dass sie Tryptasen sein müssen, was aber chemischem Wege noch prüfungsbedürftig ist.   Sh. Suzuki.

294. On the Structure of the Chromosome in the Salivary Gland Cell of *Drosophila melanogaster*. Y. YAMAGISHI. [Cytologia 6 (1935).] — Salivary gland nuclei and other glandular nuclei of *Drosophila melanogaster* were observed in the living condition either in a modified isotonic Ringer-Locke solution or in liquid paraffin, in which the structure of the chromosomes remained unaltered longer than in the former solution. For staining, Feulgen's nuclear reaction method, slightly modified, was used. The salivary gland cell chromosome (' salivary chromosome ') is, in its general shape a thin flat tape, spreading out along the surface of the nucleus generally, its flat surface facing the nuclear membrane. The chromosome consists of chromatic bands of various breath and the hyalonema (matrix) in which the bands are embedded. Any definite chromatic connections between the bands could scarcely be observed. The larger bands measure about 0.3 μ in breath, and range down to quite a thin transversal threads. Several bands show that they consists of 2-4 discrete parts or dots which arrange themselves laterally across the chromosome tape. In the so-called " chromocenter " the chromatic thread were found

by Feulgen's nucleal reaction. In some cases it showed the presence of the connections between both arms of II and III chromosomes. The "chromocenter" may be enlarged and united, attachment points covered with some achromatic substance. The nucleus was seen clearly as a body more or less irregularly round, and containing 2 or more vacuoles. The salivary chromosome may correspond in structure to an early pachyphase chromosome in meiosis, and its each band with a number of chromomeres in the zygophase or pachyphase chromosomes. The occurrence of the syndetic (synaptic) stage in the glandular organs is stated   Sh. Suzuki.

295. Untersuchungen über die Fixierung und Färbung von tierischen Geweben. 3. Mitteilung. (Japanisch.) Shuzo YUMIBA. [Osaka Igk. Z., 34 (1935).] - Die pH von Geweben, die durch 20 Arten von Fixierungsflüssigkeiten behandelt werden, verschiebs sich nach säuerer Seite als die beim frischen Zustand. Es kommt vielleicht aus experimentellen Fehlern, die ersten auf der Acidität der Fixierungsflüssigkeit und zweitens auf dem Vorhandensein des Reduktions (Alkohol, Formalin) und Reduktionsmittel (Chromsäure u. a.) zurückzuführen sind. Die Gewebs-pH ist kein alleiniger Faktor, ihre Färbbarkeit zu bestimmen.   Sh. Suzuki.

296. Über die Entwicklung der Hypophyse von *Cacopoides tornieri* aus Südkorea. (Japanisch.) Shuzo YUMIBA. [Osaka Igk. Z., 34 (1935).] — Der Verfasser hat bei verschiedenen Entwicklungsstadien der *Cacopoides tornieri*, einer Art Anura aus Südkorea, die Entwicklung der Hypophyse systematisch beschrieben und gleichzeitig mit *Rana pipiens*, *Rhacophorus schlegelii* und *Rana nigromaculata* verglichen. Sowohl Morphogenese wie histologische Differenzierung der Teile der Hypophyse (ausgeschlossen die Pars tuberalis) scheinen mit kleiner Ausnahme prinzipiell sehr ähnlich sein, wie die von *Bufo*, indem die Differenzierung von Pars tuberalis als die Übergangsform zwischen Urodelen und Anuren zu sehen ist.   Sh. Suzuki.

297. Über den Zusammenhang zwischen der Isoelektrischen Punkte der Leberzellen von Wassermolch und der Supravitalfärbbarkeit. (Japanisch.) T. MATUURA. [Osaka Igk. Z., 34 (1935).] — Mit Hilfe der Supravitalfärbungstechnik mit basischen Farbstoffen und unter besonderer Berücksichtigung der Wasserstoffionenkonzentration der Medien versucht der Verfasser zuerst festzustellen, wie sich die Leberzellen von *Triton* gegen die Reaktion der Medien verhält. Die isolierten Leberzellen von *Triton* wurden auf dem Objektträger in 0,0001%iger Janusgrün-Ringerscher Lösung (Farbstofflösung 9: Pufferlösung 1) mit verschiedener Wasserstoffionenkonzentration gefärbt. Als Pufferlösung und zwar innerhalb der Grenze von pH 2,2 bis 8,0 dient die Phosphatcitronensäuremischung nach McIlvaine. Bei einer Reaktion der Lösung pH 5,2 treten die zahlreichen isolierten oder gruppierten Mikrosomen hervor, welche für Hinweis auf das Vorhandensein selbständig koagulierender Kolloid im Plasma eine Bedeutung haben. Der IEP der Leberzellen von *Triton* wurde schon durch G. Yasuzumi als pH 5,2 nachgewiesen. So kann man schliessen, dass die Mikrosomenbildung der Leberzellen von *Triton* in Zusammenhang mit dem IEP derselben steht.   Author.

298. Über die synergische Wirkung der Vorderlappen- und Ovarialhormone auf den Uterus von kastrierten jungen weiblichen Ratte. (Japanisch.) K. NAKAYA. [Osaka Igk. Z., 34 (1935).] - Nach den Untersuchungen von Dr. Ueno und Dr. Iimuro ist es festgestellt, dass bei der Injektion von Vorderlappenhormon und von Ovarialhormon an kastrierte weibliche Maus und Kaninchen das Uterusgewicht sich enorm vergrössert. Der Verfasser prüfte diese Ergebnisse bei der Ratte nach und gelangt folgende Schlüsse. Die Versuchsreihe gestaltet sich folgendermassen: I. Vorderlappenhormon allein (5 Tage) II. Ovarialhormon allein (5 Tage) III. Kombinierte Behandlung der beiden Hormone (5 Tage). IV. Ovarialhormon 5 Tage dann Vorderlappenhormon 5 Tage. V. Umgekehrt, VI. Kontrolle. Aus den Untersuchungen von genannten Autoren sieht man, dass das Uterusgewicht bei der IV. Gruppe am grössten. Nach meinen Versuche erweist die Gruppe III. die besten Erfolge.   Verfasser.

299. Pri la vejnoj de mano de simioj (Über die Venen der Affenhand). Seiho NISHI. [Fol. Anat. Jap., Tôkyô, 13 (1935), 407-416.] — Untersuchung an 11 katarrhinen und 3 platyrrhinen Affen (37 Exemplaren, 63 Händen) hat folgendes ergeben: — Die von den Fingern abfliessenden Venen sammeln sich auf dem Handrücken zu 6 Hautvenenstämmchen. Die V. marginalis radialis empfängt die Venen des Daumens, die Vv. digitales dorsales communes I., II.

und IV. je die Venen des 2., 3. und 4. Fingers und die V. marginalis ulnaris die des 5. Fingers, während die V. digitalis dorsalis communis III. gewöhnlich nur schwach ausgebildet ist und zuweilen fehlen kann. Die V. digitalis dorsalis communis I. (V. cephalica manus) setzt sich proximalwärts direkt in die V. cephalica antebrachii fort. Die V. marginalis ulnaris teilt sich dagegen distal zum Processus styloides ulnae in 2 Äste, von denen der volare sich in das Venennetz an der Volarseite der Handwurzel ergiesst, während der dorsale Ast, V. obliqua dorsalis auf der Rückenseite der Handwurzel schräg proximal-radialwärts verläuft, um in die V. cephalica antebrachii einzumünden. Die Anordnung der Venenstämmchen auf dem Handrücken ist individuell verschieden; sie ergiessen sich je nachdem in die V. cephalica manus oder in die V. obliqua dorsalis oder aber in die V. marginalis ulnaris ein. Eine selbständige V. basilica wurde niemals beobachtet   Verfasser.

300. Über den Nucleus ellipticus und den Nucleus ruber beim Delphin. Teizo OGAWA. [Arb. Anat. Inst. Sendai, 17 (1935), 55 61, 4 Taf.] — Nach seiner Beobachtung am Gehirn eines Delphins, *Neomeris phocaenoides* (Cuvier), behauptet Verf. von der Unabhängigkeit zwischen dem sog. Nucleus ellipticus und den Wurzelfasern des Okulomotorius. Dieser Kern entspricht zum grössten Teil dem Darkschewitschschen und zum kleinsten dem Bechterewschen akzessorischen Kern. Nicht nur gegen die Hauptkerne des Okulomotorius sondern auch gegen den Edinger-Westphalschen Kern, der bei *Neomeris* nicht besonders stark aber deutlich entwickelt ist, lässt sich der Nucl. ellipticus ziemlich scharf begrenzen. Bei diesem Delphin ist der Nucl. ruber in seinem grosszelligen Anteil recht schwach, weist jedoch in seinem kleinzelligen, der durch den frontalen und kaudalen Abschnitt des Nucl. interstitialis gebildet wird, einen relativ guten Entwicklungsgrad auf   Verfasser.

301. Beiträge zur vergleichenden Anatomie des Zentralnervensystems der Wasser-säugetiere: über die Kleinhirnkerne der Pinnipedien und Zetazeen. Teizo OGAWA. [Arb. Anat. Inst. Sendai, 17 (1935), 63 136, 65 Fig. auf 32 Taf.] — In bezug auf die äussere Form der Pinnipedien- (*Phoca, Callorhinus* etc.) und Zetazeencerebella (*Lagenorhynchus, Neomeris, Balaenoptera* etc.), ist Verf. der Meinung, dass bei diesen Tieren Lobulus paraflocularis, besonders medialer Teil seines Crus superius, der bei Otariiden und Zetazeen gegen Lobulus paramedianus unscharf begrenzt wird, beträchtlich gut entwickelt, während der eigentlichen Flocculus im Gegensatz zu den Ansichten von Jelgersma und Bolk nur schwach angelegt ist. Nach Beobachtungen an frontalen sowie sagittalen Schnittserien sind die Kleinhirnkerne der oben genannten Tiere in vier, Nucl. medialis, Nucl. interpositus anterior, Nucl. interp. post. und Nucl. lateralis zu unterscheiden. Das Hauptgewicht wurde dabei auf das Ergebnis gelegt, dass die sehr grosse graue Masse innerhalb des Zetazeencerebellum, die seit Alters her bekannt gewöhnlich als Nucl. dentatus bezeichnet worden ist, entspricht grösstenteils dem Nucl. interpositus post., d. h. dem Nucl. globosus des menschlichen Kleinhirns, zum geringen Teil aber auch dem Nucl. lateralis. Die Kleinhirnkerne des Seebären ähneln sich zum Teil näher den der Phoziden, zum Teil den der Zetazeen, wie diese Verhältnisse auch die äussere Gestaltung der Kleinhirnkerne dieser Tiere betreffen. Weiter ist die Ansicht gesprochen, dass gewisse innige Formbeziehung zwischen Kleinhirnkernen und unterer Olive existieren kann. Der kolossal grosse Nucl. interp. post. der Zetazeen hängt wahrscheinlich mit der riesengrossen medialen Nebenolive dieser Tiergruppe innig zusammen, während der relativ klein angelegte Nucl. lateralis cerebelli mit der unteren Hauptolive direkt verbunden zu sein scheint. Bezüglich der funktionellen Lokalisation in Kleinhirnkernen liegt aus Vergleich der Grösse dieser Kerne zwischen Menschen und Wassersäugern die Vermutung nahe, dass der Nucl. lateralis mit Extremitätenmuskeln, der Nucl. interp. post. mit hinteren Rumpfmuskeln, besonders mit dem Schwanzteil in inniger funktioneller Beziehung steht; diese Meinung widerspricht nicht zur seit Bolk von verschiedenen Autoren behaupteten funktionellen Lokalisationstheorie der Kleinhirnrinde.   Verfasser.

302. Über die Kernfixierungswirkung von Fixierungsflüssigkeiten. (Japanisch.) Kensei TERATO. [Osaka Igk. Z., **34** (1935).] — Um zu prüfen, ob das Koagulationsvermögen der Hefenukleinsäure durch verschiedenen Fixierungsmittel mit ihren Fixierungsbilder des Zellkerns in Beziehung steht, wurden die Versuche sowohl im Reagenzrohr als auch in Schnittpräparaten durchgeführt. Die in dieser Arbeit erhaltenen Resultate lassen sich wie folgt zusammen-

fassen: 1) Das Koagulationsvermögen durch Pikrinsäure sowohl durch Chromsäure ist sehr stark, was hauptsächlich auf der Azidität derselben zu beruhen scheint. 2) Das Vorhandensein von Essigsäure im Fixierungsmittel steht im engeren Zusammenhang mit der Permeabilität der Zellmembrane der Fixierungsmittel und mit der Koagulation der Kernchromatine, da der IEP der Kernchromatine ein sehr niedrig ist. 3) Die Koagulationsmenge der Hefenukleinsäure durch verschiedenen Fixierungsmittel hängt nicht immer von dem Chromatingehalt des Zellkerns an.

<div align="right">Autor.</div>

Abstracts

303. A Cytological Study on the Maturation and Fertilization of the Egg of *Hyaobius retardatus* **(An Urodelan Amphibian).** Sajiro MAKINO. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 3 (1934), 117–167, 29 figs., 4 pls.] — I. Maturation. In the egg taken from the ovary at the breeding season, the germinal vesicle has occupied a position about a midway on a radius through the animal pole. When the egg is about to leave the ovary, it has located close to the periphery of the egg. The disintegration of the germinal vesicle is initiated by breaking down of its border which causes the outflow of the contents. The chromatin threads in the vesicle is now converted into bivalent chromosomes and move nearer to the egg periphery in preparation for the 1st polar division. The first polar spindle is formed when the eggs are still at the upper part of the oviduct and during their passage down the middle part of the oviduct the course of the division is advanced. The first polocyte is found in a shallow depression on the surface of the egg, having an oval outline 0.042–0.050 mm in diameter when fresh. The second polar spindle appears when the egg reaches the lower part of the oviduct and advances as far as the metaphase. In this condition the eggs pass down to the end part of the oviduct where they stay until spawning takes place. The haploid number of chromosomes is 20 in the polar divisions. II. Fertilization. About 1 to 1 $^1/_2$ hours after insemination the second division is completed. 2 or more hours after the entry of a spermatozoon, the female pronucleus is found metamorphosed at the periphery of the egg. Then it begins to travel back towards the centre increasing in size considerably. On the other hand, the entire spermatozoon enters the egg as early as 15 minutes after insemination. The male pronucleus is found already metamorphosed within 1 hour after the penetration. The conjugation of the two pronuclei occurs during 5 to 6 hours after insemination. The position in which two pronuclei meet, is eccentric towards the animal pole; they meet at the distance of about 1/4 to 1/3 of the egg diameter from the upper pole along the egg-axis through the second polocyte and the centre of the egg. At the time of conjugation male and female pronuclei are quite similar in their structure and size, 0.038–0.042 mm in diameter. After they come in contact they do not actually fuse, but lie side by side in close contact but separated by the nuclear membrane. The paternal and maternal nuclear elements remain in distinct groups during the preparatory stages for the first cleavage division and the chromosomes are found independently in the respective nuclear vesicles. The first cleavage spindle usually appears about 7 hours after insemination.   Author.

304. A Comparative Study of the Chromosomes in the Indian Dragonflies. J. J. ASANA and S. MAKINO. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 4, No. 2 (1935), 67–86, 10 figs., 2 tabs.] — The numerical and morphological relations of chromosomes were studied in 10 species of dragonflies from Western India. The studied species are as follows: Fam. Libellulidae — *Pantala flavescens, Tramea limbata, Trithemis pallidinervis, Diplacodes trivialis, Brachythemis contaminata, Crocothemis servilia, Potamarcha obscura* and *Orthetrum sabina*; Fam. Aeschnidae — *Ictinus rapax*; Fam. Coenagrionidae — *Ceriagrion rubiae.* All the members of the Libellulidae show a constancy in number of chromosomes, 25 in diploid and 13 in haploid. In *Ictinus rapax* (Aeschnidae), the diploid is 23 and the haploid 12. In *Ceriagrion rubiae* (Coenagrionidae), 27 in diploid and 14 in haploid. In all species studied there is always present an unpaired X-chromosome which shows post-heterokinesis. In Libellulidae, on the whole, the X-chromosome seems to be of almost uniform size in every species, being nearly equal in magnitude next above the smallest autosome in the spermatogonial complex. In *Ictinus* the X-chromosome is represented by the largest element in the complex. In *Ceriagrion,* the condition of the X-chromosome resembles that of the same element in the members of Libellulidae. The smallest chromosome, the so-called m-chromosome, is present without exception in all species above mentioned. It varies in magnitude from species to species. The varying magnitude of this element relative to the size of the X-chromosome in each species is given in a table.   Authors.

305. The Chromosomes of the Edible Crab, *Paralithodes camtschatica* **(Tilesius).** Hidejiro NIIYAMA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 4, No. 2 (1935), 59–65, 3

figs.] — The spermatogonium contains 208 chromosomes which range in length from rod to dot, showing gradual diminution in size. The haploid number of chromosomes is determined to be 104 in both of the primary and secondary spermatocytes. Throughout the meiotic phases the author could not identified the heterochromosome by its particular form and behavior. Recent studies on the heterochromosomes in some decapods are shortly discussed.   Author.

306. The Chromosomes of a Japanese Spiny Lobster, *Panulirus japonicus* (de Haan). Hidejiro NIIYAMA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 5, No. 1 (1936), 21–28, 12 figs., 1 tab.] — In the spermatogonial metaphase the diploid complement consists of 140 chromosomes of which 12 are atelomitic V-shaped elements, while the remaining ones are all telomitic rods showing gradual diminution of size. The atelomitic chromosomes have nearly submedian attachment of the spindle fibres and constitute 6 homologous pairs. The present species is the first representative of the decapods known to have the polymorphic nature of chromosomes. The primary spermatocyte contains, in the metaphase, 70 tetrads, of which some larger, ones are compound ringtetrads derived from the atelomitic V-shaped chromosomes. The all tetrads separate into equal halves and there are found no special chromosomes which are particular in shape and behavior. The secondary spermatocyte metaphase shows 70 dyads, showing a complete half set of the spermatogonial chromosomes. The author's suggestion based upon his own findings and the data hitherto obtained from various species of the decapods by many other authors is that fragmentation and association of chromosomes may play an important rôle for variations of the chromosome number in the decapod crustacean species.   S. Ichikawa.

307. Studies on the Sex and Chromosomes of the Oriental Human Blood Fluke, *Schistosomum japonicum* Katsurada. Kahei IKEDA and S. MAKINO. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 5 (1936), 57–71, 16 figs., 3 tabs.] — The chromosome complex in both sexes of *Schistosomum japonicum* consists of 16 chromosomes, of which 2 pairs are atelomitic V-shaped and the remaining 6 pairs are telomitic rod-shaped showing intergrading size. Any special chromosomes, acceptable for XY or XX were not absolutely discernible in both sexes of this dioecious trematode. No sexual differences were detected between the male and female cercariae. In this connection a more complete understanding would be expected from the evidences of infection experiments which showed that mammals invaded by cercariae from a single snail usually yield worms of one sex and that neither male nor female worm living under the unisexual infection within the final host becomes mature. The discussion is also about the cause of the predominance of the unisexual parasitism in the intermediate host, *Onchomelania nosophora*.
                    S. Ichikawa.

308. The Spiral Structure of Chromosomes in the Meiotic Divisions of *Podisma* (Orthoptera). Sajiro MAKINO. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 5, No. 1 (1936), 29–40, 4 figs., 1 pl.] — The spiral structure of chromosomes was studied in the meiotic chromosomes of the grasshoppers, *Podisma sapporoense* and *P. mikado* (Acridiidae), with smear preparations applying the fixative to the slide. The chromonemata appear as deeply stained and coiled threads which are optically differentiated from the matrical substance within the chromosomes. The chromosomes of the first division seemed to be of double-coiled structure. Evidence is presented that each chromatid forming the meiotic chromosome contains 2 chromonema spirals; hence 4 chromonemata exist in a dyad and 8 in a tetrad. The structural features of chromosomes was compared with that discovered in some plants.   Author.

309. Zur Ichneumonidenfauna von Tosa (II). Subfam. Cryptinae. Toichi UCHIDA. [Ins. Mats., 11, No. 1 & 2 (1936), 1–20, 4 figs.] — Beschreibungen von 31 Arten und 5 Formen; darunter 4 Gattungen, 12 Arten und eine Form für die Wissenschaft neu sind. Neue Gattungen: *Nippocryptus* [Typus — *Hemiteles suzukii* Matsumura], *Caenocryptoides* [Typus — *Ischnojoppa tarsalis* Matsumura], *Paragambrus* [Typus — *Gambrus sapporonis* Uchida], und *Chasmocryptus* [Typus *Plectocryptus hokkaidensis* Uchida]. Neue Arten: *Goniocryptus tosaensis, Habrocryptus shikokuensis, Hoplocryptus sugiharai, Hygrocryptus wadai, Mesostenus (Mesostenus) discoidalis, Hemiteles (Aenoplex) fukuiyamensis, Hemiteles (Itamus) okamotoi, Gelis susakiensis, Giraudia spinosa, Microcryptus tosaensis, Stylocryptus (Stylocryptus) sugiharai,* und *Phygadeuon kochiensis.* Neue Form: *Endrus flavofasciatus* f. *nigrinotum.*   .   S. Kuwayama.

310. The Chromosomes of Six Species of Ant-lions (Neuroptera). J. J. ASANA and Hisao KICHIJO. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 5 (1936), 121-136, 6 figs.] — The number of chromosomes and the type of sex-chromosomes are studied in the male germ cells of 6 species of ant-lions from India.

Species		Haploid	Diploid	Sex-chromosome
(a)	Myrmeleonidae			
1.	*Myrmecaelurus* sp. (*M. acerbus?*)	7	14	XY
2.	*Macronemurus* sp.?	8	16	XY
3.	*Neuroleon* sp.	8	16	XY
4.	*Myrmeleon* (*M. sagax?*)	7	14	XY
(b)	Ascalaphidae			
5.	*Ogcogaster segmentator*	—	22	XY
6.	*Glyptobasis dentifera*	—	22	XY

Authors.

311. Beitrag zur Kenntnis der Fungivoriden-Fauna Japans. II: Diadocidiinae (Dipt.). Ichiji OKADA. [Ins. Mats., 11, No. 1 & 2 (1936), 21-24, 1 fig.] — Beschreibung von *Diadocidia ferruginosa* f. *thoracica* n. S. Kuwayama.

312. Beitrag zur Kenntnis der Fungivoriden-Fauna Japans. III: Ditomyiinae (Dipt.). Ichiji OKADA. [Ins. Mats., 11, No. 1 & 2 (1936), 56-60.] — Eine Art, *Symmerus antennalis*, für die wissenschaftliche Welt neu ist und die 2 anderen, *Symmerus annulatus* und *Ditomyia macroptera*, aus unserem faunistischen Gebiet noch nicht beschrieben worden sind.

S. Kuwayama.

313. A New and Four Unrecorded Species of Phaoniinae (Dipt., Muscidae) from Japan. Shizuo KATO. [Ins. Mats., 11, No. 1 & 2 (1936), 24-27, 3 figs.] — A new species is described under the name *Trichopticus michitanii*. S. Kuway..ma.

314. Die Cerambyciden aus den Kurilen (Col.) (Achter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 11, No. 1 & 2 (1936), 28 35.] — Notizen über 28 Arten. S. Kuwayama.

315. Beitrag zu den *Pytho*-Arten Japans (Col.). Hiromichi KÔNO. [Ins. Mats., 11, No. 1 & 2 (1936), 35-37.] — Notizen über 3 Arten, von denen eine Art, *Pytho jezoensis*, für die Wissenschaft neu ist. S. Kuwayama.

316. A New *Cicada*-species from Honshu. Shonen MATSUMURA. [Ins. Mats., 11, No. 1 & 2 (1936), 38.] — Description of *Cicada hooshiana*. S. Kuwayama.

317. Erster Nachtrag zur Ichneumonidenfauna der Kurilen (Subfam. Cryptinae und Pimplinae). Toichi UCHIDA. [Ins. Mats., 11, No. 1 & 2 (1936), 39-55.] — Notizen über 26 Arten und 2 Formen der Cryptinen und 18 Arten und 3 Formen der Pimplinen, von denen 9 Arten und 2 Formen für wissenschaftliche Welt neu sind. Neue Arten: *Cryptus kônoi*, *Cecidonomus sugiharai*, *Hemiteles* (*Hemiteles*) *shanaensis*, *Hemiteles* (*Opisthostenus*) *etorofuensis*, *Gelis shikotanensis*, *Plectocryptus albitarsis*, *Microcryptus maruyamensis*, *Phygadeuon kurilensis* und *Ephialtes nonmanifestator*. Neue Formen: *Habrocryptus assimilis* f. *yezoensis* und *Polysphinctopsis eximia* f. *nigrithorax*. S. Kuwayama.

318. New *Caccobius*-species in Japan with a Tabular Key. Shonen MATSUMURA. [Ins. Mats., 11, No. 1 & 2 (1936), 61-66.] — 13 species of *Caccobius* are found in Japan, 8 of which are new to science. New species: *C. hirayamai*, *C. jononis*, *C. kasuganus*, *C. narashinensis*, *C. sapporoensis*, *C. suzukii*, *C. yubariensis* and *C. yamauchii*. S. Kuwayama.

319. Fauna of the Thysanoptera in Japan (Part. VII). Masato ISHIDA. [Ins. Mats., 11, No. 1 & 2 (1936), 67-74, 3 figs.] — Original descriptions of *Thrips physapus* f. *brunnea*, *Taeniothrips saussureae* and *Thrips fuscicornis*. S. Kuwayama.

320. Eine neue *Chermes*-Art (Adelgiden) auf Hokkaido. Motonori INOUYE. [Ins. Mats., 11, No. 1 & 2 (1936), 75–80, 3 figs.] — Beschreibung von *Chermes ishiharai* sp. nov. Die Fundatrix dieser Art findet man wie bei *Ch. japonicus* im Frühjahre (Mitte April) an der Basis der Winterknospe von Fichtenzweigen (*Picea canadaensis*) sitzend, dicht in weisser Wolle eingehüllt. Nach dreimaliger Häutung wird sie zur Stammutter. Die Stammutter beginnt auf parthenogenetischem Wege Eier abzulegen. Die Zahl von den Stammutter abgelegten Eier kann etwa 235 bis 685 Stücke betragen. Nach etwa 10 Tagen entkriechen aus diesen Eiern Junglarven, die zwischen die sich bildenden Gallenschuppen (in die Kammern) zur gelangen suchen. Die entstehende Galle ist kurz, rund und klein (Länge 12 bis 17 mm, Breite 9 bis 13 mm). Im Juli oder schon im Juni springt die Galle auf und entlässt die mit Flügelstummeln versehenen Nymphen, die sich nochmals häuten und zu geflügelten Individuen werden. Diese geflügelten Läuse verbleiben zum Teil auf dem gleichen Baum, auf dem sie entstanden sind, zum Teil fliegen sie auf andere Fichten (*Picea sitchensis*) über. Sofort beginnen die geflügelten Läuse mit der Ablage von etwa 12 bis 34 Eiern, die sie an den Fichtennadeln absetzen und über denen sie absterben. Die daraus nach etwa 10 Tagen ausschlupfenden Junglarven saugen nur kurze Zeit an den Nadeln und wandern dann auf die Winterknospe, am hier im ersten Larvenstadium den Winter zu verbringen.   S. Kuwayama.

321. Die von Herrn O. Piel gesammelten chinesischen Ichneumonidenarten. Toichi UCHIDA. [Ins. Mats., 11, No. 3 (1937), 81–95, 8 figs.] — Beschreibungen von 22 Arten und 6 Formen; darunter 9 Arten, 4 Formen und 2 Gattungen für die Wissenschaft neu sind. Neue Gattungen: *Neoheresiarches* [Typus — *N. albipilosus*] und *Pielia* [Typus — *P. concava*]. Neue Arten: *Protichneumon pieli, P. flavitrochanterus, Metopichneumon chinensis, Coelichneumon pieli, Neoheresiarches albipilosus, Eupalamus longisuperomediae, E. sinensis, Pielia concava* und *Melanichneumon (Bystra) kulingensis*. Neue Formen: *Amblyjoppa japonica* f. *kulingensis, Protichneumon moiwanus* f *maxima, Coelichneumon bilineatus* f. *sinicus* und *Melanichneumon (Bystra) albipictus* f. *sinicus*.   S. Kuwayama.

322. Die Malacodermen aus den Kurilen. II (Neunter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 11, No. 3 (1937), 96-98.] — Notizen über 5 Arten der Lyciden, 1 Art der Lampyriden, 5 Arten der Canthariden, 1 Art der Dasytiden und 1 Art der Cleriden.   S. Kuwayama.

323. Eine neue *Epilachna*-Art. Hiromichi KÔNO. [Ins. Mats., 11, No. 3 (1937), 99, 1 fig.] — Beschreibung von *E. pustulosa* n. sp.   S. Kuwayama.

324. On New and Two Unrecorded Species of Aphididae from Japan. Motonori INOUYE. [Ins. Mats., 11, No. 3 (1937), 100–105, 1 fig.] — Description of *Cinara nopporoensis* parasitic on *Picea Glehni* and records of *C. vanduzei* Swain parasitic on *P. jezoensis, P. excelsa* and *P. canadensis* and *Lachniella costata* Zetterstedt parasitic on *P. canadensis*.   S. Kuwayama.

325. A Preliminary Revision of Genus *Spinaria* Brullé (Hymen., Braconidae). Chihisa WATANABE. [Ins. Mats., 11, No. 3 (1937), 106–117, 1 fig.] — Based on the coloration of the wings and abdomen, 13 species and 4 varieties of the genus *Spinaria* are arranged in four groups.   S. Kuwayama.

326. Zwei Fungivoriden von der Insel Uruppu in den Mittel Kurilen. Ichiji OKADA. [Ins. Mats., 11, No. 3 (1937), 118–120, 1 fig.] — Notizen über *Allocotocera pulchella* (Curtis) und *Neurotelia nemoralis* (Meigen).   S. Kuwayama.

327. Two New Species of *Caccobius* (Scarabaeidae). Shonen MATSUMURA. [Ins. Mats., 11, No. 3 (1937), 120–121.] — *C. matsuoi* and *C. amagisanus*.   S. Kuwayama.

328. Three New and One Unrecorded Species of Odonata from Korea. Teiichi OKUMURA. [Ins. Mats., 11, No. 3 (1937), 122–128, 4 pls., 2 figs.] — Descriptions of *Ophiogomphus forficula* n. sp., *Gomphus emarginatus* n. sp., *Gomphus coreanus* (Doi et Okumura) n. sp. and *Davidius lunatus* Bartenef.   S. Kuwayama.

329. Die von H. Hori auf der Ins. Meshima gesammelten Curculioniden. Hiromichi KÔNO. [Ins. Mats., **11**, No. 3 (1937), 129-130.] — Beschreibungen von *Orochlesis meshimensis* n. sp., *Rhynchaenus horii* n. sp. und *Apion (Squamapion) griseopubescens* Roelofs.
S. Kuwayama.

330. An Observation on the Behaviour of the Adult of *Lema oryzae* under the Eclipse of the Sun. (Preliminary report). Satoru KUWAYAMA. [Jour. Sapporo Soc. Agr. & Forest., **28**, No. 135 (1937), 428.] — The activity of the adult of the rice leaf-beetle, *Lema oryzae*, was very much decreased in the course of the eclipse showing the similar condition of activity to that in the evening (about in 6.30 p. m.) except the mating activity.   Author.

331. On *Margaronia (Glyphodes) nigropunctalis* Brem., a Serious Pest to Ash (*Fraxinus mandschurica*) in Hokkaido. Motonori INOUYE. [Jour. Hokkaido Forest Soc., **35**, No. 408, (1936), 539-542.] — The Pyralid, *Margaronia nigropunctalis*, occurred abundantly in the summer of 1936, causing a considerable damage on the foliage of ash. In Hokkaido, it produces two generations each year and the adults emerge in June and September to October.
S. Kuwayama.

332. A Modification of the Harington and Van Slyke Extraction Chamber. (Blood Gas Studies Performed with a New Micro-Blood-Gas-Apparatus. I.) Koichiro SAITO [Jour. Biochem., **25**, No. 1 (1937), 79-87.] — A modified form of the extraction chamber of Harington and Van Slyke is described, which is applicable to 0.1 cc of the sample. The analytical results demonstrate satisfactory accuracy, the probable error found in the blood gas analysis being 0.83% for CO_2 and 1.49% for O_2.   Y. Kimura.

333. Sur la Teneur en Cholestérine des Ongle de quelques Animaux. Kazuo HOTTA et Kenzo TAKAGI. [Jour. Biochem., **25**, No. 1 (1937), 109-111.] — The content of cholesterol of the claw is various according to kinds of animals. Generally speaking, however, it is higher in mammals than in birds.   Y. Kimura.

334. Studies on Lipase. III. Report. Effect of Ovarian Follicular Hormone on the Pancreatic Lipase. Yoshio IWASAKI. [Jour. Biochem., **25**, No. 2 (1937), 177-179.] — A demonstration in vitro of an intimate relationship between fat metabolism and the sex hormone. The commercial "ovahormone" preparation promotes the synthetic reaction and retards the hydrolytic reaction of pancreatic lipase.   Y. Kimura.

335. The Effect of Ultraviolet- and Röntgen-Rays on the Redox-Potential of the Frog Muscle in Vivo. Yukimaro UCHIMURA. [Jour. Biochem., **25**, No. 2 (1937), 207-217.] — An optimal dosage of irradiation causes the rise of the reduction potential in vivo and in vitro as well. The effect appears promptly after the irradiation in the case of ultraviolet-rays but it appears gradually in the case of Röntgen-rays. These results obtained potentiometrically can also be confirmed chemically, that is, the content of reduced glutathion is found to be increased in the tissue irradiated.   Y. Kimura.

336. Untersuchung der Krötengalle. VI. Konstitution der Trioxy-isosterocholensäure. Tayei SHIMURA und Taro KAZUNO. [Jour. Biochem., **25**, No. 2 (1937), 245-249.]
Y. Kimura.

337. Studien über die Konstitution des Octopins, eines stickstoffhaltigen Körpers in den Octopodenmuskeln. Syûzo ASAKI. **I. Mitteilung: Eigenschaften und Abbau des Octopins.** [Jour. Biochem., **25**, No. 2 (1937), 261-280.] **II. Mitteilung: Synthetische Versuche.** [Ebenda, 281-290.] **III. Mitteilung: Stereochemische Untersuchung mittels der Drehkurvenmethode nach Lutz.** [Ebenda, 291-298.] — I) Aus der analytische Befunde wurde das Octopin eine dem Guanidinderivat zugehörende Dicarbonsäure zu sein geschlossen, II) und weiter durch den synthetischen Versuch, bei dem das d-Arginin und das dl-α-Brompropionsäure als Ausgangsmaterial verwandt wurde, wurde die Strukturformel des Octopins klargestellt wie folgt:

$$NH-CH(CH_3)-COOH$$
$$NH_2$$
$$HN=C-NH-CH_2-CH_2-CH_2-CH-COOH$$

d-Guanido-butyl-äthylamin-α,α′-Dicarbonsäure
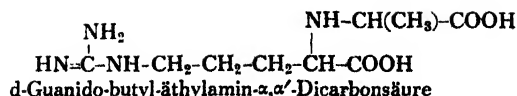
Hierauf ist das Octopin als eine Iminodicarbonsäure zu betrachten, welche man in der belebten Natur erst, und zwar zunächst bei Octopus festgestellt hat. III) Die stereochemische Untersuchung eines Isomers des Octopins, der aus dem Reaktionsgemisch von d-Arginin und d-α-Brompropiensäure isoliert werden konnte, ist angegeben.   Y. Kimura.

338. Studies on Bog Lakes I. Bog Lake at Tokotan. (Japanese.) Yoshine HADA. [Jap. Jour. Limnol., 6 (1936), 143-151; 7 (1937), 13-30.] — A small brown water lakes (150 m × 47 m, depth 3.5 m) near the east end of Hokkaidô was surveyed nine times in 1934-1935. It is surrounded by the growths of *Sphagnum, Menyanthes trifoliata* and *Equisetum polustre*. The transparency of the water ranged between 1.15-1.70 m and it depended upon the amount of zooplankton, especially Rotatoria. The maximum water temperature in summer reached 22.2°C and the surface was frozen in the winter months. The water was in most cases acid and the oxygen in the deep water disappeared in summer. The zooplankton was much more abundant than the phytoplankton. A rotifer *Keratella quadrata* was the dominant species of the summer plankton and it occurred in the deoxygenated strata too. There were also many other anaerobic ciliata.   D. Miyadi.

339. Cladocera of Lake Tôhutu of the Island of Kunasiri (S. Kuriles). (Japanese.) Kenzo KONDO. [Jap. Jour. Limnol., 6 (1936), 152-154, 1 pl.] — Besides two species of Cladocera having hitherto been known from this lake two more species are recorded here, viz. *Daphnia cucullata* (G. O. Sars) and *Diaphanosoma brachyurum* (Liévin), the former of which has been known from Hokkaidô too.   D. Miyadi.

340. Biological Investigation of Inland Waters of Sikoku, Especially of Tokusima Prefecture. I. Potamoplankton of the Yosino River (I). (Japanese.) Syuiti MORI. [Jap. Jour. Limnol., 6 (1936), 155-162.] — The potamoplankton of the fresh water area of the Yosino-gawa, the longest river (236 km) in Sikoku Island, is composed chiefly of diatoms while the zooplanktens are rare, and most of them are supplied by ponds and lakes connected with the river or from the river bottom. The regional differences in the quality and quantity of plankton are small.   D. Miyadi.

341. Changes of External Form after the Metamorphosis of Japanese Lampreys. (Japanese.) Shun OKADA. [Jap. Jour. Limnol., 7 (1937), 1-8.] — The metamorphosis of some lampreys was pursued by rearing them, and the following points were made clear. *Lampetra planeri* (Bloch) lacks the secondary sexual characters and its dorsal fins are separate until about a month before the metamorphosis. In the full grown lamprey the teeth exhibit degeneration and the body length diminishes by 2-3 cm. *Lampetra fluviatilis minor* Kudo et Asada is based on a young specimen of *L. fluviatilis. Lampetra mitsukurii* Hatta also seem to be identical with *L. fluvialtilis.*   D. Miyadi.

342. Ecological Investigation of a Freshwater Shrimp, *Leander paucidens* (de Haan) in Lake Towada. (Japanese.) Isao MATSUI and Teiitıro WAINAI. [Jap. Jour. Limnol., 7 (1937), 31-44.] — This common shrimp is found abundantly everywhere in the shallow water zone of Lake Towada in northern Japan. It becomes rare below the depth of 30 m, though found at 60 m too. No definite relationship was recognized between the population density of the shrimp and the bottom nature or the vegetation. The male shrimp is smaller in size than the female, and the former is found more numerously on deeper bottom. The number of eggs brooded by the shrimp increases directly proportional to the body length.
                                    D. Miyadi.

343. General Features of some Formosan Lakes in Winter. (Japanese.) Denzaburo MIYADI. [Jap. Jour. Limnol., 7 (1937), 55-63.] — The water was in circulation at about 18.8-21.8°C in January, 1937, and the temperature of the deposits was 0.5-1.0°C higher than that of

the bottom water. The bottom fauna in most of the lakes was very poor in winter as in other seasons. Ryûran-tan near the south end of the island has alkaline water and was very rich in molluscs (*Melanoides scabra* and *M. obliquegranosa*) as well as their empty shells.

D. Miyadi.

344. A Contribution to the Study of the Inland Waters of Kwantung. (Japanese.) Masatake YAMASAKI. [Jap. Jour. Limnol., 7 (1937), 78-84.] - Four water reservoirs in Kwantung were studied for the water temperature, pH, oxygen content and plankton. They are eutrophic and the prodigious development of water bloom chiefly of *Clathrocystis aeruginosa* was seen in three of them. Of zooplanktons, *Ploesoma truncatum, Bosminopsis deitersi, Asplanchna priodonta, Trichocera cylindrica, Diaphanosoma brachyurum* and *Filinia longiseta limnetica* were the dominant species.

D. Miyadi.

345. *Petalocotyle nipponica*, a New Type of the Trematode Family Allocreadiidae. Yoshimasa OZAKI. [Proc. Imp. Acad., 10, No. 2 (1934), 111-114, 2 figs.] - Description of a new genus and a new species of Trematode, which is having a large acetabulum projected prominently from the venter, and bearing at its margin petal-like appendages. The presence of a lymph canal system is also remarkable.

K. Inoue.

346. Occurrence of *Priapulus caudatus* in Northern Japan. Shiro OKUDA. [Proc. Imp. Acad., 10, No. 2 (1934), 115-116, 3 figs.] — Description on the specimen found in the vicinity of Akkeshi Marine Biological Station. Species belonging to this genus are very rare in Japan.

K. Inoue.

347. Notes on the Early Development of a Stalked Medusa. Kin-ichiro HANAOKA. [Proc. Imp. Acad., 10, No. 2 (1934), 117-120, 8 figs.] - Observation on *Thaumatoscyphus distinctus*. The sperm is very small, having a triangular head piece and a long tail of about 70-80 μ. Diameter of the egg is about 50 μ. First cleavage occurs two or three hours after fertilization. When 16-32 blastomeres are formed, endoderm formation by unipolar proliferation begins to occur. The gastrula then becomes elongated and in 30-40 hours a planula is formed. The planula, having no segmentation cavity and no cilia on the ectoderm, can creep somewhat in the manner of earthworm.

K. Inoue.

348. Kalzium im Blut des Regenwurms. Kiyoshi AOKI. [Proc. Imp. Acad., 10, No. 2 (1934), 121-124, 3 Tab.] — Ca-Gehalt im Blut von *Pheretima hilgendorfi* (Mchlen.) wurde durch die veränderten Krammer-Tisdallschen Methode nach B. Groak oder durch dieselben von F. F. Tisdall verbesserten Methode bestimmt. Der Mittelwert beträgt 32.9 mg per 100 gr Blut. Dieser Wert wird gesteigert, wenn CO_2-Gehalt der Atmungsluft zunimmt. Nach dem Verfasser ist es wahrscheinlich, dass diese Erhöhung des Kalks im Blut von den Kalkdrüsen abhängt, aber nicht endgültig.

K. Inoue.

349. Über *Molstyela*, eine merkwürdige neue Gattung von einfachen Ascidien. Asajiro OKA. [Proc. Imp. Acad., 10, No. 5 (1934), 222-294, 1 fig.] — Beschreibung von *Molstyela izuana* nov. gen., nov. sp. Es ist merkwürdig dass diese Gattung in der inneren Organisation eine echte *Styela* ist, äusserlich aber die Merkmale einer typischen *Molgula* aufweist.

K. Inoue.

350. Male-female Superposition of the Sea-star *Archaster typicus* Müll. et Trosch. Hiroshi OHSHIMA and Hayato IKEDA. [Proc. Imp. Acad., 10, No. 2 (1934), 125-128, 1 fig.] — Ecological observation of the behaviour of the tropical sea-star.

K. Inoue.

351. Sexual Size-dimorphism in the Sea-star *Archaster typicus* Müll. et Trosch. Hiroshi OHSHIMA and Hayato IKEDA. [Proc. Imp. Acad., 10, No. 3 (1934), 180-183, 2 figs.] — Biometrical study of the ray-length which is meant for the distance from the center of the mouth opening to the tip of the arm. The mean value of males, as measured in 222 individuals was 55.47 ± 0.194 mm and that of females, as measured in 189 individuals was 59.02 ± 0.288 mm. The ratio of the ray-lengths for each of the 171 pairs of male-female superposition was distributed from 68 to 124, where the ray-length of the female in each pair was taken as 100. The mean value of these ratios was 94 ± 0.006.

K. Inoue.

352. A New Subterranean Copepod from Japan. Masuzo UÉNO. [Proc. Imp. Acad., 10, No. 4 (1934), 229±232, 1 fig., 1 tab.] — Description on *Eucyclops nagasaki* sp. nov.
K. Inoue.

353. Pharmakologische Untersuchungen über ,, Senso ", eine chemische Droge aus abgetrockneten Hautsekret der Kröte. Yoshito KOBAYASHI. [Proc. Imp. Acad., 10, No. 2 (1934), 129-132, 5 Textabb., 1 Tab.] **II. Mitteilung. Eingehende Analyse der Wirkung des ψ-Bufotalin und des ψ-Bufotalinbromides auf die Kalt- und Warmblüter-herzen.**
K. Inoue.

354. An Experimental Study of the Compensatory Hemopoiesis in Urodelan Embryos. Atsuhiko ICHIKAWA. [Proc. Imp. Acad., 10, No. 5 (1934), 240-243, 1 fig.] — The author cultured the embryo of *Hynobius retardatus* at gastrula-stage in a high oxygen milieu for 10 to 20 days. By this treatment he could achieve, eliminating any possible injury to the organism, to suppress the development of the primary red corpuscles, the cells of the ventral blood island, before they enter into the circulation. It was ascertained that in such anemic embryo, the end-cardial or myocardial cells became the chief source of the compensatory hemopoiesis.
K. Inoue.

355. Comparaison des *Limnatis granulosa* provenant de la Formose et de la Martinique. Asajiro OKA. [Proc. Imp. Acad., 10, No. 5 (1934), 286-288, 1 fig.] — Les *Limnatis granulosa* de la Formose et de la Martinique offerent dans leur coloration des différences assez définies, pour qu'il soit possible de les distinguer au premier coup d'oeil, tout en conservant les caractères morphologiques externes de l'espèce.
Auteur.

356. A New Athecate Hydroid from Misaki. Masao IWATA. [Proc. Imp. Acad., 10, No. 5 (1934), 289-291, 1 fig.] — Description on *Stylactella misakiensis* n. sp.   K. Inoue.

357. An Experiment on the So-called Interaction between Transplanted and Normal Limbs. Hiroshi TAKAYA. [Proc. Imp. Acad., 10, No. 5 (1934), 295-298, 2 figs.] — A limb disc was grafted in dorso-dorsal orientation to the limb forming territory of the host. The graft was situated dorsal, ventral, anterior or posterior position with respect to the normal limb disc of the host. Each rudiment developed invariably and produced a few days later two limb-buds parallel. The establishment of the symmetry relationship between the transplanted and the normal limb was limited to those cases where two limbs fused together in the internal cartilagenous structure. On the other hand, superficial fusion of two limbs in their soft parts as well as separated development of them did not cause any change in the imparted parallel direction. From these experimental results, we can not support the hypothesis of " Symmetriefaktor " of Wilhelmi.
K. Inoue.

358. Über das Vorkommen von *Styela partita* im Japan. Asajiro OKA. [Proc. Imp. Acad., 10, No. 3 (1932), 184-186, 1 fig.] — Eine Art von *Styela*, die an der Küste von Yokohama ziemlich häufig vorkommt, wurde geschrieben, und sie wurde vom Verfasser mit der oben genannten Art identifiziert.
K. Inoue.

359. Some Characteristics of *Soboliphyme* sp., a New Nematode from *Martes zibellina sahaliensis* Ognev. Kyojiro SHIMAKURA. [Proc. Imp. Acad., 10, No. 3 (1934), 187-190, 2 figs.]

360. Membrane Potential of the Muscle as a Determining Factor of Excitability. Seiichi OKABE. **Part I. Influence of chlorides on membrane potential and on excitability of the frog's sartorius muscle.** [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 1-15, 10 tabs.] **Part II. Action of hypertonic Ringer's fluid on Membrane potential and on excitability of sartorius muscle of the frog.** [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 17-23, 2 tabs.] **Part III. Action of carbon dioxide on the frog's sartorius muscle.** [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 25-34, 2 figs., 3 tabs.] **Part IV. Effect of fatigue due to prolonged stimulation on the frog's sartorius muscle.** [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 35-40, 1 tab.] **Part V. Effect of glucose**

-Ringer's fluid and extremely hypertonic Ringer's fluid on the frog's sartorius muscle. [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 41–44, 2 tabs.] Part VI. Action of calcium chloride on the frog's sartorius muscle. [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 45–48, 1 tab.] Part VII. Action of NaSCN on the frog's sartorius muscle. [Jap. Jour. Med. Sci., III, Biophys., 3, No. 1 (1935), 49–53, 1 fig., 1 tab.] — An attempt was made to find the relation, if exist, of the surface polarization (the membrane potential) of the muscle cell to the excitability of it. Half of the muscle was placed under the action of the various solution and the other half was kept under normal condition. The potential difference between the two parts was measured. The threshold voltage of the condenser discharge for the minimal contraction of the muscle was then determined. The excitability of the muscle was represented numerically by the threshold voltage. The experimental results were as follows. KCl, $MgCl_2$, $BaCl_2$ or $SrCl_2$ were added to normal Ringer's solution in the concentration of 10^{-5} mol or 10^{-4} mol. When these chloride Ringer's solutions were applied to the one half of the muscle, both membrane potential and excitability were increased, but when the solution was concentrated more than 10^{-2} mol, the membrane potential was decreased, and also the complete loss of the excitability (KCl) or considerable fall of it (the other 3 chlorides) occurred. By the application of hypertonic Ringer's solution also both membrane potential and excitability were diminished. In the presence of carbon dioxide, the excitability and membrane potential were lowered. Complete recovery of the change could be attained after soaking with Ringer's fluid. By prolonged stimulation injury potential fell profoundly. Glucose-Ringer's solution or $CaCl_2$-Ringer's solution (4.3 $\times 10^{-3} - 1.7 \times 10^{-2}$ mol) also lowered both injury potential and excitability. NaSCN (10^{-2} mol in Ringer's solution) increased the membrane potential and excitability. The author discussed from the experimental data the parallelism between the membrane potential and excitability.

K. Inoue.

361. The Genetics of *Drosophila virilis*. (Continued.) Mitsushige CHINO. [Jap. Jour. Genetics, 12, No. 5 (1936), 257–277, 5 pls.] — The mutants belonging to the six chromosomes discovered and located mostly by the author are described and illustrated. T. Komai.

362. Genetical Studies of the Lady-bird Beetle, *Harmonia axyridis* Pallas (Report II). Yasusi HOSINO. [Jap. Jour. Genetics, 12, No. 6 (1936), 307–319.] — The results of the experimental breeding of the lady beetle with a highly variable elytral pattern. The pattern may be classified into 6 types: s (*succinea*), A (*aulica*), S (*spectabilis*), AS, C (*conspicua*) and AC types. The factors for s, A, S and C types are autosomal and constitute a quadruple allelic series; s is largely recessive to any other factor, AS type is the hybrid between A and S. AC that between A and C, while S is a simple recessive to C. The presence or absence of a transverse ridge on the elytra is also inherited on the monohybrid basis. T. Komai.

363. Inert regions in the Autosomes of *Drosophila virilis*. Sukeiti FUJII. [Jap. Jour. Genetics, 13, No. 1 (1937), 1–3.] — In a reciprocal translocation between III and V chromosomes, the ratio in the length of the chromosomes affected by the translocation, shows a great difference between the metaphase and salivary figures. However, if the length of the inert regions are taken into calculation, this disagreement vanishes. The inert regions of those chromosomes are apparently about half as long as the whole chromosomes. T. Komai.

364. Abnormal Inheritance of the Bobbed Character of *Drosophila ananassae*. (A Preliminary Note.) Daigorô MORIWAKI. [Jap. Jour. Genetics, 13, No. 1 (1937), 4.] — A peculiar inheritance of the Bobbed factor located in the Y chromosome is reported.

T. Komai.

365. A High Frequency Non-disjunction in *Drosophila virilis*. (A Preliminary Note.) Mitsushige CHINO. [Jap. Jour. Genetics, 13, No. 1 (1937), 5.] — A strain showing ca. 5.8% secondary non-disjunction of the X-chromosome is reported. The corresponding amount in the ordinary strain is only 0.5% on the average. T. Komai.

366. The Composition of the Sex Chromosomes in the Genus *Drosophila*. (A Preliminary Note.) Hisao KATAYAMA and Hideo KIKKAWA. [Jap. Jour. Genetics, 13, No. 1

(1937), 6-8.] — Several species have similar large V-shaped X-chromosomes in the metaphase plate. Examination of salivary chromosomes reveals 3 types among them in the constitution of the X-chromosome, because of the distinctive staining reaction between the active and inert regions. The first type is rod-shaped, the second small V and the third large V. For comparison of chromosome complexes of different species, this distinction of the two regions is always to be taken into account.   T. Komai.

367. The Problem of the Sex-chromosome in the Decapod Crustacea, with Special Reference to the X-Y-chromosomes Found in *Plagusia dentipes* de Haan. (A Preliminary Note.) Hidejiro NIIYAMA. [Jap. Jour. Genetics, 13, No. 1 (1937), 37-41.] — In the metaphase of the primary spermatocyte, are found 2 peculiar chromosomes of different size, situated above and below the equatorial plate. These are probably X-Y chromosomes.   T. Komai.

368. Are Artificial Mutations Caused Directly only? (A Preliminary Note.) Yoshimaro TANAKA. [Jap. Jour. Genetics, 13, No. 1 (1937), 51-53.] — In a strain of silk-worm treated with X-rays, appeared a dominant mutation 10 generations after the treatment. This case throws doubt on the idea that the effect of radiation is always direct and simple, alleged by certain authors.   T. Komai.

369. Genetics of *Drosophila virilis*. (Continued.) Mitsushige CHINO. [Jap. Jour. Genetics, 13, No. 2 (1937), 100-120.] — Homologous genes of *D. virilis* and *D. melanogaster* are compared. No case is found where homologous genes are found in an autosome in one species and in the X-chromosome in the other. Various types of chromosome aberrations — non-disjunction, translocation, inversion — are much rarer than in *D. melanogaster*. Recessive mutants involved in various wild stocks are mentioned.   T. Komai.

370. A Study on the Development of Pigments in Various Eye Color Mutants of *Drosophila*. Kwanji MORI. [Jap. Jour. Genetics, 13, No. 2 (1937), 81-99.] — The eye color pigments may be classified into reddish and yellowish. As to their distribution in an ommatidium, primary, secondary and basal pigments can be distinguished. Various mutations in eye-color result from modifications either in distribution, quality, quantity or in the rate of development of the pigments. The mutant genes act always as inhibitors (except in the case of the change in quality). Five sets of "parallel" mutations in eye-color found between *D. melanogaster* and *D. virilis* were tested from the above view-points. Of these three have been proved to be really "parallel" in the mode of development of pigments, but two belong to questionable cases. In respect to quantity, distribution, or in the time of the first appearance of the pigments, the individuals which are homozygous for two eye-color mutant genes, show only the part which is free from the action of either gene. In consequence of combination of two genes, a "white eye" is sometimes produced. This is mainly due to the cumulative action of the combined time modifications of the two genes. In respect to the quality of reddish pigments, heterostatic relations may be perceived.
                                                                            Author.

371. Supplementary Notes on the Blephaloceridae of Japan. Siro KITAKAMI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 12, No. 2 (1937), Art. 5, 115-136, 3 pls.] — 6 species are enumerated, of which 3 from Formosa are new. In some of these species all the imago, pupa and larva are described, while in the rest only the larva is described.   T. Komai.

372. On the Physiology of the Peritoneal Melanophores of the Frog Tadpole. Kôkichi YAMAMOTO. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 12, No. 2 (1937), Art. 8, 175-186, 1 pl.] — There are 3 kinds of melanophores in the tadpole of *Rana rugosa*: the epidermal, the dermal and the peritoneal. These melanophores show some differences in their form, distribution and also in the movement of the granules within them, and these are the changes to be described as the contraction and expansion. The peritoneal melanophores respond by contraction and expansion to the decrease and increase of light respectively. The reaction to the photic stimuli coincides with that of the peritoneal melanophores of the fish *Acheilognathus*, but not with the dermal ones of the latter whose two kinds of melanophores are different in behavior. By narcotising the tadpole, all kinds of melanophores are forced to expand considerably. The

peritoneal melanophores are good material for demonstrating the ionic action of the halogenic anions. The effect of alkaloids is ambiguous. The humoral effects of hormones are variable. Adrenalin does not seem to be effective while pituitrin can keep all kinds of melanophores in an expanded state. The peritoneal melanophores react to the change of osmotic pressure, and in this it is much more sensitive than the others. To change of temperature the peritoneal melanophores are less sensitive than the other two. T. Komai.

373. Studies on the Intestinal Protozoa of Termites. III. The Distribution of Glycogen in the Bodies of Intestinal Flagellates of Termites, *Leucotermes* (*Reticulitermes*) *speratus* **and** *Coptotermes formosanus.* Masatake YAMASAKI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 12, No. 2 (1937), Art. 10, 211-224.] — The distribution of reserve glycogen deposits in 14 forms of flagellates found in the two species of termites was determined. The glycogen particles are distributed in definite correlation with the structural differentiation of the endoplasm. They are localized in the parts belonging to the nucleus, the motor apparatus and the remaining endoplasmic parts. This distribution of the glycogen granules seems to have some physiological significance. Especially those in the part adjacent to the motor apparatus are apparently the energy source of the flagellar movement, while those in the other endoplasmic parts seem to be reserve material. T. Komai.

374. Studies on the Intestinal Protozoa of Termites. IV. Glycogen in the body of *Trichonympha agilis* **var.** *japonica* **under Experimental Conditions.** Masatake YAMASAKI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B. 12, No. 2 (1937), Art. 11, 225-235.] — The mode of the change in the distribution of glycogen granules under experimental conditions, namely, starvation, incubation, oxygenation in low temperature and abrupt rise of temperature, has been determined. By these experiments it has been revealed that the anterior part of the body is probably the main region of consumption and the posterior part the region of supply of this material. This throws light on the problem of defaunation of the intestinal protozoa by means of oxygenation. T. Komai.

375. On the Locomotion Types of Certain Japanese Gastropods. Fumihiro HAYASHI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 12, No. 2 (1937), Art. 12, 237-251.] — The locomotion types in more than 20 terrestial and marine gastropods were observed and classified. They may be classified primarily into rhythmic, arhythmic, leech-like and leaping, and the rhythmic and arhythmic types may be subdivided further. The neuromuscular mechanism concerned with the locomotion is discussed. T. Komai.

Abstracts

376. Experiments on the Amphibian Mesectoderm, with Special Reference to the Cartilage-Formation. Mamori ICHIKAWA [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **12,** No. 3 (1937), 311-351.] — The present investigation, which was carried out in *Rana japonica*, concerns the prospective fates of the mesectoderm, with special reference to its cartilage formation. 1) The mesectoderm begins to migrate in mass downwards in an early neurula-stage and extends considerably before the closure of the neural folds; it does not incorporate in the formation of the neural tube as is the case of urodeles. 2) The migration of the mesectoderm is accomplished simply by the proliferation of its own cells and does not receive contributions from the dorsal portion of the neural tube as in urodeles. 3) Ventrally descending over the mesentoderm, the mesectoderm surrounds each visceral arch and assembles beneath the mesentoderm to give rise to the formation of the mesenchyme *in situ*, some of which enters into the gill. Further, some part of the mesectoderm located ventrolaterally to the neural tube is involved in the formation of the cranial ganglia. 4) The mesectoderm transplanted into the brain-cavity directly produces cartilage. The mesectoderm transplanted into the body side (somatic mesentoderm) proliferates in general and produces large pieces of cartilage in the neighbourhood of the myotomes and notochord. The mesectoderm implanted into the ectodermal tissues yields no positive result for the formation of cartilage, in spite of its ganglionic and mesenchymal differentiation. However, in such cases if the transplant is accompanied with the underlying mesentoderm, cartilage always differentiates. 5) The mesectoderm of the frog transplanted into *Hynobius nebulosus* can develop into the cartilage, if it is placed in the mesenchyme. The mesentoderm, regardless of the generic difference, is important, though not absolute, as in the case of the brain-cavity, for the cartilaginous differentiation of the mesectoderm. 6) The mesectoderm is determined in the late stage of gastrulation to produce cartilage, and when the neural folds close together it is completely individualized into each group, mandibular, hyoid and branchial. Extirpation of any group results in lack or deficiency of the corresponding cartilage. As the result of extirpation the cartilages such as supra- and infrastral, Meckel's cartilage, palatoquadrate and anterior trabecular bar are found to be derived from the mandibular group, hyoid and the first basibranchium from the hyoid group, and all the branchial cartilages are produced from the branchial groups. Among the last named cartilages, the first is only derived from the anterior group, while the rest from the posterior group of the branchial mesectoderm. 7) The basibranchium is of double origin; the large proximal portion which is produced by the union of the hyoid groups on both sides, and the small distal portion which is derived from the mesentoderm in front of the heart. The double nature of the cartilage is proved by the extirpation of all the mesectodermal elements from both sides of the head, with the resulting formation of the mesentodermal second basibranchium alone. 8) The auditory capsule is derived from the cranial mesentoderm and not from the mesectoderm. The fact is well established in both extirpation as well as transplantation experiments. 9) The hypobranchial plate is chiefly produced from the first branchial cartilage but partly also from the second branchial. If the development of the first is checked, the second substitutes for it. Author.

377. Combination of Two Limb-rudiments in Urodele *Triturus*, with Special Reference to Their Symmetry Relations. Hirosi TAKAYA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **12**, No. 3, (1937), 353-383.] — To investigate the mutual action between two limbs establishing an enantiomorphism, two limb rudiments were combined in the embryo of *Triturus pyrrhogaster* (Boie). Combination was made 1) by transplanting an additional rudiment in one of these positions, anterior, posterior, dorsal and ventral in close contact with the normal limb disc, or 2) by grafting two rudiments at the same time in a heterotopic position, the axial relation being varied in each position with respect to the *ap* and *dv* axes. Thus, in the first case the axial relation between two limbs, and in the second the relation of the combined limbs to the body axis were examined. 1) There occurred generally in compatibility in the growth between two combined rudiments. In the antero-posterior combination the posterior member, whether it

belonged to the host or to the graft, always proceeded the development of the anterior member. In the dorso-ventral combination, it was the ventral member which generally checked the development. 2) Even when two limbs developed, fusion was very frequent between them and in some cases resulted in a reversal of the prospective asymmetry in one member. The reversal of asymmetry was found to be brought about generally in the direction from harmonic to disharmonic with respect to the body side, with the resulting production of an enantiomorphism. This phenomenon was actually found in the following series of operations: a) In the *hom aa dd* transplantation in the posterior position, reversal of asymmetry took place on the side of the regular limb of the host, resulting in the production of a radial mirror image. b) In the *hom aa dd* and *het aa dv* transplantations in the antetior position, the asymmetry of the transplanted limb was reversed and mirroring in the radial plane occurred. c) In the *hom aa dd* transplantation in the ventral position, the palmar image was produced by reversing the dorsiventrality of the grafted limb. 3) In the heterotopic transplantation, two rudiments combined in the same axial direction as in (a) and (b) of the second section resulting similarly in the occurence of a radial mirror image even when their *ap* axis was inverted with regard to that of the body. 4) In the combination placing the *ap* axis of the rudiments in an antagonistic direction, reversal of the prospective asymmetry did not occur, irrespective of the fusion between them. Reduplication and anomaly. which were often met with in one or both members of the combined limbs, usually interrupted them to realize the given symmetrical arrangement, though in a few cases a figure like a radial or ulnar mirror image was actually produced according to the relative position of one rudiment with respect to the other. 5) From these facts, it appears that an interaction really exists between two combined limbs. However, the action, so far as their enantiomorphism is concerned seems to work on one side and is not reciprocal between them. That is to say, its effect is noticed only in the particular member which varies according to the different combinations. This phenomenon should be attributed to the qualitative difference within the limb disc, and the action is, therefore, to be defined as a sectional conflict and not necessarily extended to the whole limb disc.   Author.

378. Studies on Cirripedian Fauna of Japan. II. Cirripeds found in the Vicinity of the Seto Marine Biological Laboratory. Fujio HIRO. [Mem. Coll. Sci., Kyoto Imp. Univ. Ser. B, 12, No. 3 (1937), 385-478.] — 72 species of 'thoracic' cirripeds collected and identified by the author are described with many illustrations, including *Balanus granulatus* n. sp. and *Octolasmis Weberi pennatulae* n. subsp. and also 9 species named previously by him.

T. Komai.

379. Bopyrids from Tanabe Bay. IV. Sueo'M. SHIINO. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 12, No. 3 (1937), 479-493.] — Descriptions with figures of: *Pseudione longicanda* n. sp., *Procepon insolitum* n. gen. and n. sp., *Portunicepon tiariniae* n. sp. and *Anomopharyxus deformatus* n. gen. and n. sp.   T. Komai.

380. The Chromosomes of an Earwig, *Forficula scudderi* Borm. A. B. MISRA. [Jap. Jour. Genetics, 13, Nos. 3-4 (1937). 171-176.] — The spermatogonial chromosomes are 24, including an XY pair. The primary spermatocyte shows 12 bivalent chromosomes of which one is an XY set. All secondary spermatocytes have 12 chromosomes, and are distinguished into two kinds containing an X chromosome and a Y chromosome respectively. Thus *Fortificula scudderi* differs in its sex chromosome type from *F. auricularia* which has XX-Y type sex-Chromosomes.

T. Komai.

381. A Note on the Chromosomes of *Acrydium japonicum* (Orthoptera). A. B. MISRA. [Jap. Jour. Genetics, 13, Nos. 3-4 (1937), 175-176] — In the spermatogonial metaphase there are 13 chromosomes — 6 pairs of autosomes plus an X-chromosome which is easily recognizable on account of its rough contour. The autosomes exhibit a great range of size variation among themselves. The primary spermatocytes contain 7 rod-shaped tetrads in various stages of separation. The X is usually eccentric in position and goes undivided to one pole. Thus two kinds of secondary spermatocytes are produced, containing 7 and 6 chromosomes respectively. The chromosomes are all V-shaped being composed of two rods superimposed one upon the other.

These observations remind one of the cases of other *Acrydium* species reported by Robertson.

T. Komai.

382. On the Chromosomes of the Two Species of Insectivora (A Preliminary Note).

Shinkichi TATEISHI. [Jap. Jour. Genetics, 13, No. 5 (1937), 212.] — In *Crocidura* (*Pachyura*) *murina*, the gemini found in the first spermatocytic division are 20 in number. The chromosomes in the second division number 20, while the spermatogonial chromosomes are 40. The sex chromosomes are represented by a large geminus situated in the peripheral region of the first spermatocytic plate. This geminus consists of a comparatively large crooked X and a much smaller J-like Z, both having an atelomitic spindle fiber attachment. In the metaphase a part of the chromatid between X and Y is open into a ring. In *Mogera insularis* there appear 16 gemini in the first spermotocytic division, including an X Y type sex-chromosome set. The X is a rod bent in a right angle with an arm placed on the plate and the other arm parallel to the spindle axis, while the Y is a short spindle-shaped body lying parallel to the spindle axis.

T. Komai

383. Studies on Certain Enhancers of Crossing-over in *Drosophila ananassae* (A Preliminary Note).

Daigoro MORIWAKI. [Jap. Journ. Genetics, 13, No. 5 (1937), 232-233.] - By the presence of the Minute-II b gene in the male, 2.8 percent crossingovers occur in that sex. The same gene enhances the crossingover in the female also. The effect of the gene is strongest on the regions directly adjacent to its locus. T. Komai.

384. Abnormal Staining Capacity of the Sixth Salivary Gland Chromosome found in Certain Strains of *Drosophila virilis* (A Preliminary Note).

Sukeichi FUJII. [Jap. Jour. Genetics, 13, No. 5 (1937), 234-236.] — There are two different types among the wild strains of this fly with respect to the staining capacity of the sixth chromosome. In Type 1 represented by the New Orleans strain the chromosome shows a pronouncedly weaker staining capacity than in Type 2 to which all Japanese strains belong. In the hybrid between the two types the two sixth chromosomes derived from different strains lie side by side without fusing completely together. An experiment with *Gap*, *glossy* stock has revealed that while the Japanese strains produce 0.1+crossingover between *Gap* and *glossy*, the New Orleans strain does not. The *Gap* hump lethal 6 a strain derived from an American wild strain has also weakly stained sixth chromosomes, while all the 24 Japanese and Korean and one Chinese wild strains examined belong to Type 2 The number and arrangement of the individual bands in the chromosomes of the two types are identical. T. Komai.

385. A Terminal Inversion found in *Drosophila ananassae* (A Preliminary Note).

Hideo KIKKAWA [Jap. Jour. Genetics, 13, No. 5 (1937), 237-239.] — From several wild strains collected from various localities of North America, China and Japan, 5 inversions and 3 cases of superfluous chromatin have been detected. Of the inversions C III L reported first by Kaufmann in 1936 has been found in 10 out of 16 strains examined. This inversion is noteworthy first in being terminal and second in occurring in several wild strains from widely separated localities.

T. Komai.

386. On Chromosomes of some Chelonians (A Preliminary Note).

Kenji NAKAMURA. [Jap. Jour. Genetics, 13, No. 5 (1937), 240.] — In *Clemmys mutica, Geomyda spengleri, Cyclemys flavomarginata* the chromosome numbers are: 2 n=52, n=26. The chromosomes are much like those of *Clemmys japonica* previously reported, there being 4 large V's and 2 long rods. Examination of the chromosome sets of the embryo and young directly after hatching of *Caretta olivacea*, have revealed: 2 n=58 (spermatogonial), or 57 (ovogonial). In this species also 4 large V's and 2 long rods may be clearly distinguished. T. Komai.

387. Time of Stimulation and Mosaicism (A Preliminary Note).

Yoshimaro TANAKA and J. C. YOUNG. [Jap. Jour. Genetics, 13, No. 5 (1937) 243-244.] — From the silkworm eggs subjected to centrifuging in high (35°,C) or low (0°-1°C) temperature, at the stage when the embryonic body is largely laid out, 6 mosaic worms were obtained. These, except one, belonged to the bilateral type or its modifications, contrary to the recognized fact that such

mosaicism is due to disturbances in an early developmental stage. This observation may be accounted for by the assumptions: 1. the first cleavage of the egg determines the future bilateral plane of the worm; 2. the subsequent cleavage may be slightly different in tempo in the two bilateral halves of the future body; 3. the susceptability to stimulus may be somewhat different according to the phase of the nuclear division, so that, 4. the part of the body which contains the nucleus that was affected by the stimulus will show eventually an abnormal feature, while the other part that contains the unchanged nucleus exhibits a normal feature.   T. Komai.

388. On the Management of Coniferous Forest with the View of their Protection against *Ips japonicus* Niisima. Shimonji TABATA. [Rept. Saghalien Centr. Exp. Sta., No. 14, (1936), 1–152] — *Ips japonicus* is one of the injurious insects widely found in the coniferous forests in southern Saghalien. In twelve years it has devastated 179,959 hectars of forest; though its destructive power seems to be on the wane, it has not yet been quite exterminated. This beetle devors *Picea jezoensis* Carr., *P. glehnii* Masters and *Larix dahurica* Turcz., and especially when it finds weak or withered trees of the first species. This beetle has normally one generation a year, passing the winter in adult stage under the bark of food trees. The overwintering adult enters into activity under 5°–6°C, crawls out under 16.5°C, and begins to fly under 20°C, the fly height in forest being 6–7 m, often 20–30 m or more. Oviposition period extends 16 days, depositing 52 eggs, and incubation period varies 3 to 12 days among the eggs deposited by one female. Larval stage lasts 17 to 28 days and about 3 weeks on an average, and the pupal 4 to 10 days and normally 8–10 days. Thus, 44 to 80 days, or 70 days on an average, are needed for the completion of stages from egg-deposition to the adult. As predators to this beetle, *Thanasimus karafutonis* Kôno, *Xantholinus* sp., *Medetera* sp., *Chelifer* sp. ?, and *Monotarsobius holstii* Pocock ?, and as parasites *Coeloides* sp., *Ipocoelius* sp., *Pteromalus* sp. and *Trichogramma* sp. are enumarated. Thirteen birds belonging to *Doryocopus, Doryobates, Picoides, Regulus, Parus, Aegithalos, Certhia* and *Sitta* are also considered to play a rôle in the control of this pest.   S. Kuwayama.

389. Insect-fauna of Saghalien. Pt. I. Butterflies (Lepidoptera-Rhopalocera). Matuzi HORI and Koiti TAMANUKI. [Rept. Saghalien Centr. Exp. Sta., No. 19, (1937), 1–224, 8 pls.] — The present report is the result of investigation on the butterflies occurring in the island of Saghalien, inclusive of both the northern and southern parts, compiling into a historical sketch, notes, on the previous collectors, remarks on the ecological characteristics and the geographical distribution, as well as descriptions of the species, with the keys to the species, genera, and families. The number of species of butterflies occurring in the island amounts so far in all to 72, referable to 33 genera and 6 families, including one revised and 3 unrecorded species and 2 new aberrant forms. Unrecorded species: *Lethe schrenckii* Ménétriés (from Saghalien), *Melitaea athalia orientalis* Ménétriés (subspecies from Japan), and *Argynnis aphirape ossianus* Herbst (from Japan). Revised species: *Lycaena eros erotidis* Staudinger=*L. icarus fuchsi* Sheljuzhko. New aberrant form: *Argynnis adippe satakei* Nakahara ab *toyoharae* and *Zephyrus taxila* Bremer ab. *harukii*. According to the authors' investigation, Saghalien can be divided into three districts so far as the butterflies are concerned: the South-west, the South and the North districts. The South-west district has some affinity with the other two districts on the one hand, however, there are found several species such as *Papilio xuthus, Pieris melete, Lethe schrenckii* and *Lycaena lycormas* on the other hand, which are not represented in the latter districts but are distributed in Hokkaido and other islands of Japan proper. Occurrence of such species must be due to the warmer climate of the district. The insect-fauna of the North district is most closely allied to that of Amur and northern Siberia (Siberian subregion) lacking the southern elements altogetner. It must be also pointed out that such species as *Anthocaris cardamines kobayashii, Coenonympha hero pilwonis, Argynnis aphirape ossianus, A. selenis sibirica, A. selene chibiana, A. miyakei, A. pales neopales, Melitaea athalia sachalinensis, M. athalia orientali, Lycaena icarus fuchsi, Erynnis comma sachalinensis,* etc. are represented only in this district in Saghalien. The fauna of the South district consists chiefly of the elements of Siberian subregion, however there is also a slight connection with that of the Manchurian subregion. The type species in this district are *Parnassius stubbendorfi ; Coenonympha hero perseis, Argynnis oscarus sachalinensis, A. thore karafutonis, Pamphila silvius, P. palaemon murasei,* etc. *Colias palaeno orientalis* and *Lycaena optilete sibirica* are also distributed in this district, while *Oeneis jutta sachalinensis, Argynnis aphirape*

ossianus and *Everes fischeri* which are quite common in the North district are not distributed. The investigation on the distribution of butterflies in Saghalien and other neighbouring regions proves that the Tugaru Strait (Blakiston's line) appears of less importance than the Soya Strait (Hatta's line) as a boundary line of the Palaearctic fauna in Japan, so far as it concerns the insects, especially butterflies. On the other hand the fauna of insects in the South-west district of Saghalien seems to contain decidedly more elements of Japan proper than in the other districts. This fact leads us to propose a new boundary line somewhere in the northern part of Japan further north than the Soya Strait. This line is running somewhat parallel to the isothermal line in summer. Other new boundary lines in the Kuriles and the opposite continent — Amur and Ussurie districts — are also to be drawn. Of these boundary lines those in Saghalien and the Kuriles are altogether liable to lie somewhat more southward than both Miyabe's line (Etorofu Strait in the Kuriles) and Schmidt's line (from Due to Shikuka in Saghalien) which were proposed from the phytogeographical point of view.　　　　　　　　　　　　　　S. Kuwayama.

390. Chafers, or Scarabaeid Beetles, and their Relation to Agriculture. Satoru KUWAYAMA. [Bull. Hokkaido Agr. Exp Sta., No. **61**, (1937), 1-73, 5 pls. & 33 figs.] — General discussions on the Lamellicorns in relation to agriculture in Hokkaido. *Serica orientalis* Motschulsky, *Heptophylla picea* Motschulky, *Popillia japonica* Newman. *Anomala rufocuprea* Motschulsky, *A. geniculata* Motschulsky, *A. testaceipes* Motschulsky and *A. cuprea* Hope are enumerated as more important pests in Hokkaido and described all stages, with notes on their life-histories and instances of the injury they have been observed to cause. *A. rufocuprea*, A. *geniculata* and *P. japonica* attack the foliage of fruit trees, vegetables and other crops in adult stage and also attack the roots of cereals, vegetables and many other crops in larval stage. Adults of *A. testaceipes* feed chiefly on larch, but the larvae are very injurious to the roots of cereals, vegetables, etc. Adults of *H. picea*, of which larvae have been known to injure young spruce trees, occasionally feed on rice, but have not found on other cultivated plants. Injuries done by *S. orientalis* and *A. cuprea* are also restricted in adult stage. *H. picea* and *S. orientalis* complete their life-cycles in a year, whereas the species of *Anomala* and *Popillia* require two or three years for development. Other subterranean insects attacking cultivated plants in Hokkaido are mentioned to be comparable with the Lamellicorns. They include *Bourletiella pruinosa* Tullberg, *Gryllotalpa africana* Parisot de Beauvois, *Agrotis ypsilon* Rottenburg, *A. informis* Leech, *Euxoa segetum* Butler, *Rhyacia c-nigrum* Linné, *Barathra brassicae* Linné, *Chortophila flavopicta* Matsumura, *C. cilicrura* Rondani, *Nephrotoma minuticornis* Alexander, *Agriotes fuscicollis* Miwa, *Corymbites puncticollis* Motschulsky, etc. Natural enemies of the Lamellicorns include various birds, such as *Spodiopsar cineraceus* Temminck and *Sturnia philippensis* Forster, the Tachinid, *Centeter cinerea* Aldrich, and the Asilid, *Promachus yesonicus* Bigot; the descriptions and notes of them are also given.　　　　　　　　　　Author.

391. Ein neuer Schmarotzer von *Deudrolimus spectabilis* aus China. Toichi UCHIDA. [Ins. Mats., **11**, No. 4, (1937), 131.] — Beschreibung von *Itoplectis nigribasis.*
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392. Some New Butterflies from Japan and Korea. Shonen MATSUMURA. [Ins. Mats., **11**, No. 4 (1937), 132–134, 1 pl.] — Descriptions of *Parnassius everesmani* f. *sasai* n., *P. citrinarius* f. *kyotonis* n., *Anthocaris cardamines* f. *isshiku* (♀), *A. cardamines* f. *kobayashii* (♀) and *A. cardamines* f. *koreana* n.　　　　　　　　　　　　　S. Kuwayama.

393. Neue and wenig bekannte Käfer Japans. II. Oedemeridae. Hiromichi KONO. [Ins. Mats., **11**, No. 4 (1937), 135–146, 8 figs.] — Notizen über 17 japanischen und 4 micronesischen Arten, von denen 1 Gattung, 8 Arten, 1 Unterart für die Wissenschaft neue sind. Neue Arten: *Asclera subrugosa, Eobia matsumurai, Anancosessinia* (n. g.) *tarsalis, Schistopselaphus sonani* [Japan], *Eobia uchiyamai, E. truckana. E. gigan'ea* und *Allocacis flavipes* [Micronesien]. Neue Untrart: *Eobia chinensis kotoensis.*　　　　　　　　　　　　　S. Kuwayama.

394. Einige neue Formen der japanischen Bockkäfer nebst Bemerkungen über Synonym und geographische Verbreitung. M. MATSUSHITA u. K. TAMANUKI. [Ins. Mats., **11**, No. 4 (1937). 146–149] — Neue Aberrationen: *Leptura variicornis* ab. *anticerufa,*

L. variicornis ab. *inornata, Strangalia vicaria* ab. *fujisana, S. vicaria* ab. *asahinai*, und *S. subtilis* ab. *ohishii*. Neue Varietät: *Bumetopia oscitans* var. *kiushuensis*.   S. Kuwayama.

895. New *Ontophagus*-species in Japan with a Tabular Key. Shonen MATSU-MURA. [Ins. Jap., **11**, No. 4 (1937), 150–169.] — Descriptions of 32 species. New species: *Onthophagus aequiperus* (Mats. et Yohena), *O. akirai, O. chibanus* (Mats. et Yohena), *O. chuzen-jianus, O. hikosanus, O. hyuganus O. ibonus, O. jedensis* (Mats. et Yohena), *O. kandai, O. kawari-nus, O. kogatanus, O. komabellus, O. kozunomis, O. matsuokai* (Mats. et Yohena), *O. minoi* (Mats. et Yohena), *O. misujianus, O. miyazakianus, O. oishii, O. okushirianus, O. oniellus, O. shigeoi, O. shurianus* (Mats. ei Yohena) *O. sobosanus, O spurius, O. takabayashii, O. ushiodai, O. yedanus, O. yubarinus, O yugianus* and *O. yumigatanus*. Newly named species: *O. yohenai* (=*O. shinanensis* f. *brevicornus* Yohena nec Fähraeus). New form; *O. yubarinus* f. *taiheizana*.   S. Kuwayama.

896. Neue und wenig bekannte Käfer Japans. III Gattung *Ixalma*. Hiromichi KÔNO. [Trans. Sapporo Nat. Hist. Soc., **15**, pt. 1 (1937) 29–32, 2 figs.] — Notizen über 5 Arten, von denen 2 Arten, *Ixalma okadai* und *I. nigriventris* für die Wissenschaft neu sind.   S. Kuwayama.

397. Nachtrag zu den Nematoceren von den Kurilen. (Diptera). Ichiji OKADA. [Trans. Sapporo Nat. Hist. Soc., **15**, pt 1, (1937), 33–39, 2 Figs.] — Beschreibungen von 8 Fungi-vorid- und 2 Bibionid-Arten. Neue Arten: *Megophthalmidia longicornis*. Neue Form: *Apemon similis* f. *nigricoxa*.   S. Kuwayama.

388. Peculiarity on the Insect-fauna of the Southern Saghalien. Matuzi HORI. [Report from the Karafuto Office, No. 5 (1937), 148–155.] — Abut 2000 species of insects are known to occur in the southern Saghalien at present. These insect-fauna, especially of butterflies, are in close relation to that of Amur and Ussurie and then to that of the Kuriles and the nor-thern Korea, while the relation to Hokkaido is rather slight. In other words, the insect-fauna of the southern Saghalien consists of Eurasiatic elements. Ecologically, reduction of generations per year, delay in sping emergence, shortness in the duration of diurnal activity, fewness in the seasonal form, richness in alpine insects, fewness in species but many in individual and possibility on frequent appearance of new pests are all peculiarity on the insect-fauna of the southern Saghalien.   S. Kuwayama.

399. On *Anobium* (*Ernobius*) *abietis* F. Motonori INOUYE. [Jour. Forest. Soc., **36**, (1937), 414–416, 3 figs.] — Brief notes on the bionomics and extent of injuries, with precautions on the controlling measures.   S. Kuwayama.

400. Onthophagid-insects from Korea with Descriptions of New Species. Shonen MATSUMURA. [Ins. Mats., **12**, No. 1, (1937), 1–3] — An enumeration of 20 species, of which 7 are new to science and described. New species: *Onthophagus amenthus, O. chosensis, O. koma, O. micellus, O. miyabei, O. nakatomii*, and *O. shoyozonus*.   S. Kuwayama.

401. Die Lamellicornien aus den Kurilen. II (Zehnter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., **12**, No. 1 (1937), 6–8] — Notizen über 9 Arten, von denen eine Art, *Aphodius* (*Agrilinus*) *etrofuensis*, für die Wissenschaft neu ist.   S. Kuwayama.

402. Einige Ichneumonidenarten aus Kotosho. Toichi UCHIDA. [Ins. Mats., **12**, No. 1 (1937), 9–12, 1 fig.] — Notizen über 7 Arten. Unter den gezeichneten Arten sind *Epirhyssa kanoi, Agrypon sulcosum* und *Xanthopimpla kriegeri* Ashmead f. *yami* für die wissenschaftliche Welt neu.   S. Kuwayama.

403. Ibalinae of Nippon (Hym., Cynipidae). Keizo YASUMATSU. [Ins. Mats., **12**, No. 1 (1937), 13–18, 1 pl.] — A list of the species of the Genus *Ibalia* of Nippon, a key to the species, and descriptions of *I. takachihoi* n. sp. and of the male of *I. japonica* Matsumura as well

as some comparisons among the species are given. S. Kuwayama.

404. Beitrag zur Kenntnis der Fungivoriden-Fauna Japans. IV: Macrocerinae (Dipt.) Ichiji OKADA. [Ins. Mats., 12, No. 1 (1937), 19–27, 3 figs.] — Notizeu über 6 Arten. Neue Arten: *Macrocera abdominalis, M. alpicoloides* und *M. ezoensis.* S. Kuwayama.

405. Die Ptilininen Japans (Col.) Hiromichi KONO et Hun Kyu KIM. [Ins. Mats., 12, No. 1 (1937), 28–31, 2 figs.] — Notizen über 5 Arten. Neue Arten: *Ptilinus cercidiphylli, P. galloisi* und *P. formosanus.* S. Kuwayama.

406. New Japanese Ichneumonidae parasitic on the Sawflies. R. A. CUSHMAN. [Ins. Mats., 12, No. 1 (1937), 32–38] — Descriptions of 5 new species based on material reared from cocoons of *Diprion nipponicum* Rohwer and *Neodiprion sertifer* Geoffroy; viz., *Pezoporus annulaticrus, P. opacus, Delomerista japonica, Lephyroplectus nipponensis,* and *Lamachus albopictus.* S. Kuwayama.

407. On Some Species of Braconidae from Manchoukuo (Contributions to the Knowledge of the Braconid Fauna of Manchoukuo, I) Chihisa WATANABE. [Ins. Mats., 12, No. 1 (1937), 39-44, 1 fig.] — Notes and descriptions of 9 species, of which a new one *Apanteles kariyai* is included. S. Kuwayama.

408. Beitrag zur Kenntnis der Fungivoriden-Fauna Japans. V: Lygistorrhininae (Dipt.) Ichiji OKADA. [Ins. Mats., 12, No. 1 (1937), 45–48. 1 fig.] — Beschreibung von *Lygistorrhina pictipennis* sp. nov. S. Kuwayama.

409. Eine neue *Alcides*-Art aus Korea (Col. Curc.). Hiromichi KÔNO. [Ins Mats., 12, No. 1 (1937), 49, 1 fig.] — Beschreibung von *Alcides saitoi* sp. nov. S. Kuwayama.

410. Eine neue Unterart der *Bredhos parthenias* Linnaeus aus Japan (Beiträge zur Kenntnis der Systematik der Geometriden Japans. I). Takahisa SAWAMOTO. [Ins. Mats., 12, No. 1 (1937), 50–52, 2 figs.] — Beschreibung von *B. parthenias hilara* subsp. nov. S. Kuwayama.

411. On One New Species of Earthworm belonging to the Genus *Pheretima* from North-eastern Honshu, Japan. S. HATAI and S. OHFUCHI. [Saito Ho-on Kwai Mus., Res. Bull., XII (1937), 1–11, 2 figs.] — *Pheretima servinus* is described as new to science. Fine illustrations are given, and described in full are the external charaters, internal characters, and the habitat. S, Ohfuchi.

412. Descriptions of Three New Species of the Genus *Pheretima* from North-eastern Honshu, Japan. S. OHFUCHI. [Saito Ho-on Kwai Mus., Res. Bull., XII. (1937), 13–29, 4 figs.] — Three new species, *Pheretima hataii, Ph. gomejimensis* and *P. oyuensis* are described, illustrated and fully dealt with as to internal and external characters. *Pheretima oyuensis* was found to be without spermathecae, male pores, prostatic ducts and prostate gland. Author.

413. On the Species Possessing Four Pairs of Spermathecae in the Genus *Pheretima*, Together with the Variability of some External and Internal Characteristics. S. OHFUCHI. [Saito Ho-on Kwai Mus. Res. Bull., XII (1937), 31-136, 36 figs., and 1 pl.] — The main object of the study was to determine the number of species of *Pheretima* in North-eastern Honshu, which possess four pairs of spermathecae, to study their limits ·of variation in regard to external and internal characteristics. The study shows that certain revision must be made, especially in external characteristics, such as the variation of the oriffice, the position and the number of genital papillae which are usually located close to the spermathecal openings. Also variation was noticed in regard to the presence or absence on the left or right side only or on both sides of the male pores. Author.

414. Echiuroidea, Sipunculoidea and Priapuloidea obtained in North-east Honshu, Japan. H. Sato. [Saito Ho-on Kwai Mus. Res. Bull. XII (1937), 137–176, 14 figs, and 3 pls] — The following species are dealt with, namely: Urechis unicinctus (von Drasche), *Ikeda taenioides* (Ikeda), *Arhynchite arhynchite* (Ikeda), *Sipunculus nudus* Linnaeus, *Siphonosoma cumanense* (Keferstein), *S. mourense* Sato, *Physocosoma japonicum* (Grube), *P. scilops* (Selenka et de Man), *Phascolosoma vulgare* (de Blainville). *P. zenibakense* Ikeda, *P. catharinae* F. Müller, *P. onagawa* Sato, *P. hozawai* Sato, *Dendrostoma blandum* Selenka et de Man, *D. hexadactylum* Sato, *Phascolion ikedai* Sato, *P. dentalicola* Sato, and *Priapulus bicaudatus* Danielssen. Among these, three are described as new to science, namely, *Phascolosoma onagawa*, *P. hozawai* and *Phascolion dentalicola*.   S. Ohfuchi.

415. Notes on the Amphibia of the Tohoku Districts, Northern Japan. Yaichiro Okada. [Saito Ho-on Kwai Mus. Res. Bull., XII (1937), 172–206, 13 figs., and 3 pls.] — The species mentioned in his report are, *Triturus pyrrhogaster* Boie *Hynobius lichenatus* Boulenger, *H nigrescens* Stejneger, *Onychodactylus japonicus* (Houttuyn), *Bufo vulgaris formosus* Boulenger, *B. vulgaris montanus*, sp. nov., *Hyla arborea japonica* Guenther, *Rana nigromaculata nigromaculata* Hallowell, *R. japonica* Guenther, *R. temporaria ornativentris* Werner, *R. rugos* Schlegel, *Racophorus schlegelii schlegelii* Guenther, *R. schl. arborea* Okada et Kawano, *Polypedates buergeri* (Schlegel). Full descriptions and the localities are given in detail.   S. Ohfuchi.

416. Additional Pyramidellidae from Siogama Bay, with Remarks on the Molluscan Fauna, Especially Pyramidellidae from Sagami Bay; being a Comparative Study. Shichiroku NOMURA. [Saito Ho-on Kwai Mus. Res. Bull., XIII, 11–107 (1937). 11 pls.] — As the second contribution to the Pyramidellidae fauna of Siogama Bay, the author makes a comparative study with the fauna of Sagami Bay, adding a list of the molluscan shells from Sagami Bay, and comparing them with that of Siogama Bay. From Siogama Bay, the author reports 30 species, which include the following new species, *Odostomia* (Odostomia) *exiguita, O. (O.) kotorana, O. (O.) bentizimana. O. (O.) crassicallosa, O. (O.) jucundio, O. (O.) eronea, O. (O.) asapera, O. (O.) pallidior, O. (O.) perplexissima, O. (O.) sitiroi, O. (O.) tritestata, O. (O.) profundiperforata, O. (O.) neoexigua, O. (O.) makiyamai, O. (O.) bullata, O. (O.) tenerissima, O. (O.) dilecta, O. (Sinuatodostomia) sinuosa, Menestho (Menestho) cingulitissima, Siogamaia odostomides, S. kinkwazan, Chrysallida (Chrysallida?) semipunctata, Agatha infrequens, Turbonilla (Turbonilla) eupellucida* and *T. (Pyrgiscus) bisculpta*. Also one new section Crenatodostomia and one new subgenus *Sinuatodostomia* have been established. In the material from Sagami Bay 56 species are recorded. Among them, the new ones are. *Syrnola (Syrnola) hasimotoi, S. (S.) azona, S. (S.) zona, Odostomia (Odostomia) sagamiana, O. (O.) vera, O. (O.) dusiensis, O. (O.) kanagawaensis, O. (O.) miuraensis, O. (Sinuatodostomia) watarui, Chrysallida (Miralda) koheii, C. (M.) tempeii, C. (M.) sitizoi, Siogamaia quantoensis, Cingulina (Cingulina) biarata, Turbonilla (Turbonilla) hasimotoi, T. (T.) kanagawana, T. (T.) ridiculosa, T. (T.) mollita, T. (T.) mira, T. (T.) cura, T. (T.) mala, T. (Pyrgiscua) valdissima, T. (P.) deae, T. (P.) hataiana, T. (P.) miura, T. (P.) miurana, T. (P.) bona, T. (P.) pseudorex, T. (Dunkeria) dusiana,* and *T. (Sulcoturbonilla) quantoana*. This report is the second one to the Pyramidellidae fauna of Japan, and is very valuable from various points of view. It includes beautiful illustrations and many descriptions.   S. Ohfuchi.

417. On Some Recent Venerid Mollusca from North-east Honsyu, Japan. Shichiroku NOMURA. [Saito Ho-on Kwai Mus. Res. Bull., XIII (1937), 7–10, 1 pl.] — The author deals with the species of the genus *Protothaca*, and finds that for the species *adamsii* Reeve, the new generic name *Protocallithaca* should be proposed. From Hukusima prefecture, he has described one new species, *Procothaca schencki*. From this report, we can now see the general features of the Protothaca-fauna of northern Japan. Fine illustrations and full descriptions added with remarks are given.   S. Ohfuchi.

418. On the Variation of *Neptunea arthritica* Bernardi from Northern and Central Honsyu, Japan. Shichiroku NOMURA and K. HATAI. [Saito Ho-on Kwai Mus. Res. Bull., XIII (1937), 1–5, 2 pls.] — This article deals with the variation of the common whelk, *Neptunea arthritica* Bernardi, a species distributed from Central to Northern Honsyu, and showing significant variation according to localities. The environment and variation in regard to localities

are described, and the following new forms are recognized, forms *tyosi*, forma *syobuta*, forma *matusima* and forma *asamusi;* and for a fossil form, the name forma *miyata* is proposed. With these forma names proposed, the writers find that each of the forms indicates a particular kind of sculpture, and that by comparing these different kinds of sculptures with the fossil specimens from the Kwantô region of Central Japan, explanations to the past climatological conditions during the deposition of the Pleistocene Narita beds of the Kwantô region may be solved in part.   S. Ohfuchi.

419. Foraminifera from Siogama Bay, Miyagi Prefecture, Japan. K. ASANO. [Saito Ho-on Kwai Mus. Res. Bull., XIII (1937), 109–119, 2 pls.] — Altogether 78 species are listed, and among them the new ones are, *Pyrgo siogamensis* and *Eponides orientalis.* Species originally described from fossil materials are also well represented in the recent ones from the Bay, thus giving a rather long geological range to them.   S. Ohfuchi.

420. Limnological Researches of Onne-to in the Akan Region (Hokkaido). (Japanese.) Yoshine HADA and Takuo CHIBA. [Jap. Journ. Limnol., 7, No. 3 (1937), 113–120, 3 pls., 2 figs.] — This small volcanic-barrier lake (0.21 sq. km, greatest depth 9.8 m, altitude 610 m) of the seepage type was surveyed twice. It has disharmonic acidotrophic water with pH 5.2. In winter were collected under the ice-cover two kinds of zooplanktons, *Keratella quadrata* and *Arcella vulgaris* and about 10 species of diatoms. In summer following zooplanktons were seen, *Cyclops leuckarti, Daphnia longispina hyalina, Bosmina coregoni, Notommata* sp., *Keratella quadrata* and *K. cochlearis,* but their population was very small and the phytoplanktons were fewer in summer than in winter. No fish was found in the lake because it has no surface drainage.
                                                                                                                         D. Miyadi.

421. On the Animals of the Yuhuin Hot-spring (North-eastern Kyusyu). (Japanese.) Yuichi ITO. [Jap. Journ. Limnol., 7, No. 4 (1937), 150–157, 8 figs.] — Faunal survey of some carbonate hot-springs near Yuhuin gained the following animals: *Rana japonica, Aplocheilus latipes, Phoxinus steindachneri, Stratiomyia japonica, Gerris lacustris, Laccobius* sp., *Lycosa pseudo-annulata, Caridina denticulata, Lymnaea japonica, Semisulcospira libertina* and *Stenothyra* sp. The temperature and pH of the water in which animals occurred ranged between 34.5–45.8°C and 7.2–8.75 respectively. The most resistant was *Laccobius* sp., which was found in the water of 45.8°C. No animal was seen in the water with temperatures higher than 50°C. While *Rana, Laccobius, Stratiomyia* and *Lymnaea* are rather common inhabitants of many Japanese hot-springs, *Caridina* and *Stenothyra* are rare examples.   D. Miyadi.

422. Biological Investigations of Inland Waters of Sikoku, especially of Tokusima Prefecture. I. Potamoplankton of the Yosino River (2). (Japanese.) Syûiti MORI. [Jap. Journ. Limnol., 7, No. 4 (1937), 158–172, 7 figs.] — The plankton was collected quantitatively by a water bottle in both fresh and brackish water areas of the Yosino River to ascertain its vertical distribution and the influences of tide as well as other environmental factors on it. The Potamo-planktons are more numerous in the deeper layer rather than near the surface, and this is explained by the fact that a considerable portion of them is supplied from the river bottom. In the brackish water area, greater number of planktons are collected in the high water of the tide than in the low but the smallest population occurs a short time after the lowest level of the tide.   D. Miyadi.

423. Report on the Sipunculoidea, Echiuroidea and Priapuloidea collected by the Sôyô-Maru Expedition of 1922–1930. H. SATÔ. [Sci. Rep., Tohoku Imp. Univ., Ser. IV, 9, No. 1. (1934), 1–32, 1 pl.] — The author describes the following species and varieties. Sipunculoidea: 1) *Sipunculus nudus* Linnaeus, 2) *Siphonosoma* sp., 3) *Phascolosoma vulgare* var. *tropicum* Sluiter, 4) *P. margaritaceum* var. *antarcticum* Michaelsen, 5) *P. appendiculatum,* n. sp., 6) *P. glossipapillosum,* n. sp., 7) *P. hyugense,* n. sp., 8) *P. noto,* n. sp., 9) *P. signum,* n. sp., 10) *P. soyo,* n. sp.. 11) *Dendrostoma ellipticum,* n. sp. Echiuroidea: 12) *Thalassema* sp. (?). Priapuloidea: 13) *Priapulus bicaudatus* Danielssen. The occurrence of Priapuloidea in Japanese waters was reported for the first time.   S. Nomura.

424. On the Mechanism of Fertilisation and Development without Membrane Formation in the Sea Urchin Egg, With Notes on a New Method of Artificial Parthenogenesis. Isao MOTOMURA. [Sci. Rep., Tohoku Imp. Univ., Ser. IV (Biol.), 9, No. 1 (1934), 33–45. 10 figs.] — 1) The formation of the fertilization and hyaline membranes was inhibited by previously activating the eggs of the sea urchins, *Strongylocentrotus nudus*, *S. pulcherrimus* and *Pseudocentrotus depressus* with the solution of butyric acid in sea water. The development without membrane formation thus was caused by the effect of the parthenogenetic activator and that of the sperm combined together. 2) Isotonic, hypertonic and hypotonic urea solutions act as parthenogenetic activators. The egg of *S. pulcherrimus* developed to a gastrula when treated with the isotonic urea solution at first and then with the hypertonic sea water. 3) The butyric acid sea water and urea solution are alike in their activating effect. 4) The hyaline membrane was dissolved in the urea solution, but not in the butyric acid sea water.

S. Nomura.

425. On the Coelomic Corpuscles in the Body Fluid of Some Invertebrates. I. Reaction of the Leucocytes of a Holothuroid, *Caudina chilensis* (J. Müller), **to Vital Dyes.** Toshio OHUYE. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV, 9, No. 1 (1934), 47–52. 5 figs.] — The reactions of coelomic corpuscles of *Caudina chilensis* to trypan blue and carmine were examined. The white, fusiform, brown and minute corpuscles ingested these dyes abundantly or sparsely, while red and crystal corpuscles ingested none of them. The author classifies the white corpuscles into two groups: the leucocytes and amoebocytes with colorless spherules. The former show active ingestion of vital dyes, while the latter show none or less active ingestion. The coelomic corpuscles tend to agglutinate in the drawn out perivisceral fluid. The cells forming the clotting are chiefly leucocytes.

S. Nomura.

426. On the Coelomic Corpuscles in the Body Fluid of Some Invertebrates. II. On the Coelomic Corpuscles of an Earth Worm, *Drawida Hattamimizu*, **Hatai.** Toshio OHUYE. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV, 9, No. 1 (1934), 53–59. 1 fig. & 2 pls.] — The body fluid of *Drawida hattamimizu* contains five types of leucocytes: the lymphocytes, monocytes, granulocytes, lamprocytes and linocytes. The perivisceral fluid contains detached chloragocytes and peritoneal cells in addition to leucocytes. The lymphocytes, monocytes and peritoneal cells show the positive reaction to the vital staining with trypan blue and carmine. The vital preparation of linocytes contained also granules of trypan blue in rare cases. The eosinophilic granulocytes constitute about 32% of the total leucocyte count, and make the characteristic feature of the blood picture of *Drawida hattamimizu*. The thread-like substance in the linocytes could not be detected.

S. Nomura.

427. Contributions to the Physiology of the Ascaris. II. The Respiratory Exchange in the Ascaris, *Ascaris megalocephala* **Cloq.** Yoshiyuki TORYU. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV, 9, No. 1 (1934), 33–70. 3 figs.] — *Ascaris megalocephala* is facultatively anaerobiotic. The worm in Ringer's solution containing oxygen consumes oxygen until the oxygen tension in the medium is lowered down to about 0.03% in volume. The worm also produces carbon dioxide in deoxygenated Ringer's solution, though the amount is much less than it produces in the presence of oxygen. The total amount of carbon dioxide produced in 24 hours at 38°C. was from 80 cc (female) to 200 cc (male) per 100 gm of the worm in the presence of oxygen, and from 20 cc (male) to 80 cc (female) in the absence of oxygen.

S. Nomura.

428. Experimental Note on the Presence of Electrically Excitable Areas in the Reptilian Cerebral Hemisphere: *Clemmy Japonica.* Hideomi TUGE and Masayasu YAZAKI. [Sci. Rep., Tôhoku Imp. Univ., Ser. IV, 9, No. 1 (1934), 79–85. 4 figs.] — As the electrical excitability of the cerebral hemisphere has not been studied to a satisfactory extent, the authors took up the present experimental work. The cerebral hemisphere was electrically stimulated, and three excitable areas have been found by observing the corresponding responses. The excitable areas A, B and C are indicated in a diagram and transverse sections of these areas illustrate the arrangement of cells in these areas. Stimulation of the areas A and B provoked the movement of the head and the neck; stimulation of the area C caused movement of the jaw (opening of the mouth).

S. Nomura.

429. Inductive Effect of Tissues other than Retina on the Presumptive Lens-Epithelium. Yô K. OKADA and Yoshiki MIKAMI. [Proc. Imp. Acad., 13. No. 7 (1937) 283-285, 4 figs.] — Many authors are of opinion that variaus tissues and organs other than eye-cup also have the power to induce the lens-formation. But there has been no complete proof for it. In this paper the authors report on the study of this problem using embryos of *Triturus pyrrhogaster* as the material. The primordial eye-cup was removed from an embryo before the lens-determination and a small piece of tissues or organs to be tested was introduced in its place in order to see whether these substitutes posses the power of the formation of a lens. Here were employed nose anlage, ear vesicle, brain, heart and liver of early embryos, dorsal wall of the archenteron, neural plate, ectoderm, mesoderm and endoderm of the head region. It became clear from these experiments that all the grafts, with the exception of the dorsal lip of the blastopore, had power in inducing the lens-formation. The lenses induced in this way were always differentiated into both epithelia and fibres.   K. Inoue.

430. The Conduction Velocity in the Leg-Nerve of the Giant Crab, *Macrocheira kaempferi.* Takeo KAMADA and Haruo KINOSHITA. [Proc. Imp. Acad., 13. No. 6 (1937), 220-222, 1 fig.] — Comparing the latent periods of the contraction of the Dactylopodite, the conduction velocity of the nervous impuls was measured as a usual way. The stimuli applied to the nerve were alternating current of 50 cycles. The measured velocity was 3.9-2.7 m/sec at the temperature of 16°C-12.5°C. This value is not very different from those which have been reported in other marine crabs by Bonge and Rosenberg. It is interesting that the decrement of the velocity was not observed in such long conducting path which sometimes reached to 37 cm.
K. Inoue.

431. Parker's Effect in Melanophore Reactions of *Macropodus opercularis.* Takeo KAMADA. [Proc. Imp. Acad., 13. No. 6. (1937) 217-219 3 figs.] — Parker has shown that when a short transvere cut is made near the root of the caudal fin of *Fundulus*, melanophores quickly expand in the area from the incision to the margin of the tail. Such response was called by the author as the Parker's effect. The author proved experimentally that the anemia caused by the incision is not the primary cause of the Parker's effect. The skin color reaction of this sort relates to the nervous impuls. The author is of the opinion that the melanophore expanding nerve takes their course along the dorsal aorta, and melanophore contracting nerve along the spinal cord.   K. Inoue.

432. Means to Kill or Remove Parasitic Dipteran larvae by Their Negative Oscillotropism. Nobumasa YAGI. [Proc. Imp. Acad., **13**, No. 5 (1937). 165-168, 8 figs.] — The author succeeded in finding parasites' behavior in responce to either simple mechanical or sonic or supersonic vibrations that may be applied to combat against their damages. If the parasitized fruits exposed in the supersonic vibration, the parsites, larvae of *Drosophila suzukii*, were driven out from the fruits. The action of the vibrations on the *Crossocosmia sericariae*, which is the maggot parasitic in the pupa of silk worm, is the most important from the practical view point. Such parasites in pupae could be killed in 10 minutes from 60-100% simply ¡by the vibrations of tuning fork.   K. Inoue.

433. Negative Oscillotropism of *Drosophila* **larva to Supersonic Vibrations.** Nobumasa YAGI. [Proc. Imp. Acad., **13**, No. 5 (1937), 161-164, 3 figs.] — The Action of supersonic vibrations on the behavior of *Drosophila* larva was studied. The author observed the behavior of the animals on vertical and horizontal oscillating plane. It was discovered that the movement of larvae can be expressed by Weber-Fechner's law, that is, the velocity V of movement is proportional to logarithm of the intensity of electric current I through the oscillation bulb.
$V = K \log_{10} I$ K was ca. 0.36. In this way the negative oscillotropism was secured. The receptor of supersonic vibration was supposed to be chordotonal organ.   K. Inoue.

434. An Insect Vector of the Dwarf Disease of Rice Plant. Teikichi FUKUSHI. [Proc. Imp. Acad., **13**, No. 8 (1937), 328-331, 1 fig.] — For long time it was believed that *Nephotettix apicalis* var. *cincticeps* Uhl. (=*N. bipnnctatus cincticeps*) is the sole agent to transmit

the dwarf disease of rice plant. But the author proved that *Deltocephalus dorsalis* Motsch. acts as an another vector of the malady. K. Inoue.

435. The Effect of the Electro-tonus on the Refractory Phase of the Peripheral Nerve. II. (Japanese). Tadazi KAWARADA. [Nihon Seirigaku Zassi, 1, No. 1 (1936) 1-5, 3 figs.] — When the first stimulus is strong enough to cause "Fick's Interval", the least interval becomes shorter than the other case. But such shortening occurs only when the first stimulating current retends more than 0.05 mili-seconds. The author explained this phenomenon by the electrotonic effect which was left after the first stimulating current. K. Inoue.

436. Über die Entwicklung des Embryos von *Ascaris lumbricoides* in der Eihülle (Japanisch). Kaoru NAKATA. [Chôsen Igk. Z., 26 (1936), 509-520, 2 Tfln.] — Der Verfasser hat die mit 2%iger Chlorkalklösung behandelten Ascaris-Eier in der Zimmertemperatur oder in 25°C kultiviert, um ihre morphologischen Veränderungen in der Einhülle zu verfolgen. Die wichtigen Resultate lauten etwa folgendermassen: Das Ascaris-Ei wird zuerst in gewisser Zeit nach der Embryobildung übertragbar, und vor dem Übertragbarwerden geht wenigstens einmalige Häutung vorher, die anfangs im Schwanzteil des Embryos angedeutet ist, um schliesslich vor einigen Tagen des Übertragbarwerden im Kopf- und Schwanzteil auffallend zu werden. Als Unterscheidungsmerkmale zwischen den übertragbaren Larven und nicht-übertragbaren sind Verschwinden der Krümmung der Speiseröhren-lumen, Häutung vom Kopf und Schwanz, Entwicklung der Exkretionsorgane, Erscheinen der Seitenlinien oder der Mitellinien am Rücken und Bauch anzugeben. Sh. Suzuki.

437. Über die inneren Geschlechtsorgane der einseitig kastrierten Tiere. (Japanisch). Totarô TANAKA. [Osaka Igk. Z., 35 (1936), 2047-2057] — Der Verfasser hat die Veränderungen der inneren Geschlechtsorganen bei den einseitig kastrierten weiblichen Mäusen untersucht und etwa folgende Resultate bekommen: Bei den kastrierten jungen Tieren vergrössert sich das überbleibende Ovarium 1.7 fach wie das normale, bei den kastrierten Erwachsenen etwa 1.5 fach. Im 1.4 fach vergösserten Ovarium sinkt die Funktion ziemlich herab, während bei den 1.6 fach vergrösserten etwas aufsteigt. Die Körpergewichtszunahme nach der Kastration wird meistens von der Hypertrophie des Ovariums begleitet. Die Ovarialzyste beeinflisst bis zu einem gewissen Grad der Vergrösserung die Geschlechtsfunktion niemals, oder vielmehr steigernd. Der Uterus wird bei den jungen Tieren nach der einseitgen kastration kürzer und dicker, dagegen beiden Erwachsenen länger und schmaler. Ausserdem zeigt sich der Uterusteil der kastrierten Seite die Abnahme sowohl des Längsdurchmessers wie auch des Gewichts im Vergleich mit dem der Kontrollseite. Sh. Suzuki.

438. Über die Vererbung der künstlich vermehrten Kernzahl bei *Stylonychia mytilus.* (Japanisch). Yonetiyo KAMIYAMA. [Seiri Kenkyû. 13 (1936), 182-189, 7 Textabb.] — Die vorliegenden Untersuchungen sind in der Absicht ausgeführt, die Erbfähigkeit der operativ hervorgerufenen Kernzahlvermehrung klar zu machen. Die Resultate lauten etwa folgendermassen: *Stylonychia mytilus*, eine eigentlich 2 kernhaltige Protozoa, kann durch operativem Eingriff 3 Kerne bekommen. welche sich bis auf zweite Generation vererben können. Und solche Dreikernigkeit vererbt sich bis auf die zweiten Generation, aber auf die dritten nicht mehr. Aber bisweilen kann schon in der ersten Generation die eigentliche Zweikernigkeit auftreten. Das operativ durchgeschnittene kernlose Stück dieses Tieres ist nicht regenerationsfähig, das kernhaltige stehet dagegen ganz im Gegenteil. Der grosse Kern von Protozoa scheint keine Erbmasse in sich haben. Sh. Suzuki.

439. Über das Vitamin A im Fettorgan des Ochsenfrosches (*Rana catesbiana*). (Japanisch). Kiyohiro MATUSAKI. [Seiri Kenkyu, 13 (1936), 639-642, 4 Textabb.] — Um das Vitamin A im Fettorgane vom Ochsenfrosch nachzuweissen, hat der Verfasser 6 Gruppen von Mäusen z. T. mit Fettorgan-Substanz-haltigen Nahrung und z. T. mit ganz von solche Substanz freien gefüttert. Die Resultate sind wie folgt: Im Fettorgan von *Rana catesbiana* wird das Vitamin A gefunden, und in 1.0-1.5 gr der vom Anfang Mai bis zum Anfangs September bekommenen Organsubstanz wird es in der äquivalenten Dosis mit 1.0 gr vom Lebertran behalten. Sh. Suzuki.

440. Vier Arten von Anopheles- Moskitos in Chosen. (Englisch). Manabu YAMADA. (Keijô J. Med. 7 (1936), 191-210, 5 Tab. u. 10 Tafl.] — Seit 1932 konnte Verf. die Entwicklung von 4 Arten Moskitos in Chosen, *Anopheles sinensis*, *A. koreicus*, *A. sineroides* und *A. edwardsi* beobachten, indem er von den gefangenen Weibchen gelegten Eier im Laboratorium gezüchtet hatte. Hier hat er die Charakter der Eier, der Larven von IV Stadium und der Puppen eingehend und zwar vergleichend beschrieben.   M. Niizima.

441. Die Offenbarung des Glykogens in Protozoa. (Japanisch). Tetsuji KIMURA u. Yoshishige KONNO. [Nihon Byori K., 26 (1936) 415-419, 2 Tab.] — Mit Best'scher Karmin-Methode haben Verff. das Glykogengehalt der Protozoen wie *Noctiluca*, *Trypanosoma*, *Trichomonas*, *Amoeba*, *Entamoeba*, *Gregarina*, *Sarcocystis*, *Colpidium*, *Paramaecium*, *Spirostomum*, *Blepharisma*, *Stylonychia* und *Vorticella* untersucht. Sie enthalten grosse oder mässige Menge von Glykogen mit Ausnahme von *Amoeba proteus*, *Sarcocystis* und *Noctiluca*. Es gibt keine Beziehung zwischen dem Glykogengehalt der Protozoen und ihrer Lebensweise, d. h. Parasitentum oder freiem Leben. Die Protozoen, die sich anoxybiontisch unterhalten, enthalten nicht besonders grosse Menge von Glykogen. Das Glykogen tritt hauptsächlich in Cytoplasma auf und wenig in Vakuolen, Es offenbart sich diffus rötlich oder als kleine oder mittelgrosse Granula.   M. Niizima

442. Über die Bedeutung der Fette in Hinsicht auf Ontogenese und Phylogenese während der Entwickelung des Zentralnervensystems. Kenkichi MORI. [Nihon Byori K., 26 (1936), 544-546] - Vom Standpunkt der Ontogenese und Phylogenese hat Verf, ausser menschlichem Embryo das Hühner- und Kaninchen-embryo zur Untersuchung herangezogen, um das Verhalten der Fette während ihrer Entwicklung und ferner ihre Bedeutung kennen zu lernen. Nach den Resultaten kann man folgendermassen sagen: Das Fett des Zentralnervensystems in der Embryonalzeit wird gerade in dem Stadium, da seine Entwicklung lebhaftesten vor sich geht, sehr reichlich beobachtet, dagegen in der späteren Embryonalzeit, da die Entwicklung des Zentralnervensystems beinahe vollendet ist oder nur noch langsam fortschreitet, bleibt dieses Fett stationär oder vermindert, sogar verschwindet. Deshalb kann man mit Recht annehmen, dass das Fett im fetalen Leben für die Entwicklung ber Hirnsubstanz eine gewisse Rolle spielt, sodass es um progressiven resp. aufbauenden Sinne betrachtet werden soll. Ferner ist es annehmbar, dass bei Hühner-embryonen, die vom Eidotter ihre Nährstoff aufnehmen und dabei viel Fett als Vorrat im Körper enthalten, mehr Fett in Zentralnervensystem schon in früheren Fetalzeiten haben als Amnioten.   M. Niizima.

443. Zur Frage nach der Neubildung von Zellen im tierischen Organismus. 1. Bildung von Zellen und Blutinseln aus Dotterkugeln beim Hühnerembryo. O. B. LEPESCHINSKAJA. [Cytologia 7 (1936), 54-81 m. 5 Textfig., 4 Taf.] — Verf. hat eine Frage gestellt, ob Zellen nur aus Zellen entstehen, und beim Hühnerembryo Untersuchungen über die Entstehung der sog. Zellen aus den Dotterkugeln, die als Nichtzellen betrachtet sind, ausgeführt. Die Methodik der Untersuchungen wurden nach drei Richtungen durchgeführt, nämlich: 1. Gewöhnliche histologische Methode an frühen Entwicklungsstadien. 2. Gewebskultur. 3. Nachprüfung der durch invivo-Beobachtungen an der Kultur erhaltenen Ergebnissen an histologischen Schnitten. Die Ergebnisse sind etwa folgende: Die Dotterkugeln haben viel Gemeinsames mit den Übergangsformen zwischen protoplasmatischen Massen und Zellen. Kugeln, die aus der Dottermasse in die Subembryonalhöhle herausgefallen sind, weisen auf verschiedenen Entwicklungsstadien der Embryonen einen verschiedenen Bau des Kerns auf: „ protoplasmatische Kerne ", „ Kern mit dem Anfangsstadium der Lininnetzbildung ", völlig ausgebildeter Kern, Kerne auf verschiedenen Stadien der karyokinetischen Teilung. Die Granula der weissen Dotterkugeln bei der Gewebskultur befinden sich in Brown'scher Bewegung, die zu einer polarisierter wird und auf diesem Wege zur Entstehung des Kerns führt. Der Entstehungsprozess des Kerns fährt über eine Reihe aufeinander folgend. Aus den Dotterkugeln, die in den Hohlraum zwischen den Keimblättern gelangten, entstehen Blutinseln. Verf. ist der Ansicht, dass die Dotterkugeln, welche keine Zellen sind, also zur Lebenstätigkeit, zur formativen Prozessen und selbst zur Umwandlung in Zellen befähigt sind.   M. Niizima.

444. Über die Blutbildung und Eisenablagerung in der Milz bei Pflanzenfresser. Toku IWAO u. Masao SATO. [Nihon Byori K., 26 (1936), 317-334, 12 Textfig.] — In der Milz

der untersuchten Hüftiere (Pferd, Rind, Schwein und Ziege) sind die blutbildenden Herde in der Umgebung des Lymphfollikels in grosser Häufigkeit vorhanden. · Diese Herde sind nicht ausgesprochen in der Milz von dem 14 Tage alten Schwein, und dem Wachstumsgrad des jungen Schweins entsprechend werden die Herde allmählich auffallender. Die Milz wird also zuerst im postfetalen Leben zum blutbildenden Organ. Die Menge des abgeschiedenen Eisens in der Milz ist beim erwachsenen Pferde am grössten und relativ klein am erwachsenen Schwein. Diese Eisenabscheidung scheint zur gefressenen Oxalsäure abhängig zu sein. Dem Fortschreiten des Alters entsprechend nimmt das Eisen an Menge zu. Die Tatsche, dass die Abscheidungsorte des Eisens in der Milz des Pflanzenfresser immer blutarm sind und die grosse Menge Eisens extrazellulär abgeschieden ist, lehrt uns dass einmal in der Milz abgeschiedenes Eisen zu Hämoglobinbildung nicht mehr benutzt wird. In der Milz der Fleischfresser kann man kleine blutbildende Herde erkennen, sie liegen aber nicht in der Umgebung des Lymphfollikels.   M. Niizima.

445. Über die Epiphyse bei einigen wasserbewohnenden Säugetieren. Gennosuke FUSE. [Arb. Anat. Inst. Sendai, **18** (1936), 241-341.] — Sehr genaue Beschreibungen über die Epiphysengegend bei *Latax lutris* L., *Phoca vitulina* L., *Phoca hispida largha* Pallas, *Callorninus ursinus* Gray, *Delphinus longirostris* Gray, *Lagenorhynchus obliquidens* Gill, *Balaenoptera borealis* Lessen und *Neomeris phocaenoides* Cuvier. Epiphyse ist bei *Latax*, *Phoca* und *Callorhinus* gut entwickelt, bei *Neomeris* rudimentär erhalten, bei *Delphinus*, *Lagenorhynchus* sowie bei *Balaenoptera* vollständig fehlend. Ausdehnung, Form und Lage der Epiphyse, ihre Höhle, ihre Höhenverhältnisse zum Ganglion habenulae und der Taenia thalami, dann die Struktur sowie dass sub- und suprakommissurale Epithelorgan sind in dieser Arbeit näher berichtet. Mit dem Namen „ Organon supracommissurale " meint Verfasser das besondere Epithel der Epiphysenhöhle, welches sich oberhalb der Commissura posterior vorfindet und strukturell dem subkommissuralen völlig gleicht. Die markhaltigen Nervenfasern, die von der Commissura habenularum und der Commissura intermedia des Epiphysenstiels herkommend in den Randschichten der Epiphyse nach hinten verlaufen, sind auch nach der Tierart in verschiedener Menge, Verteilung und Länge bemerkbar.
                                                                                    T. Ogawa.

446. Über eine strukturelle Besonderheit am Kern (oder der Substantia gelatinosa Rolando) der spinalen Quintuswurzel beim Seeotter (*Latax lutris* L.). Yoshimichi SUZUKI. [Arb. Anat. Inst. Sendai, **18**(1936), 235-240, 4 Taf.] — Verfasser bemerkte beim Seeotter eine ungewöhnliche starke Entwicklung der traubenförmigen Zellgruppen im Oblongatasegment der Substantia gelatinosa Rolando der spinalen Quintuswurzel, und zwar entsprechend der Höhe der kaudalen Zweidrittel der unteren Olive. Suzuki meint, dass diese eigenartige Bildung als Endstätte der Lingualisfasern des N. trigeminus gelte, die zu den weit auf der Vorderzunge verbreiteten Geschmacksendapparaten bei diesem Tiere in Beziehung stehen.   T. Ogawa.

447. Über die Entwicklung der perilymphatischen Räume im Gehörorgan der Anuren. Hideo SHIOBARA. [Hokuetsu Igk. Z., Niigata, **51**(1936), 1107-1138.] — Ausführliche Beobachtung über den Entwicklungsmodus des Saccus und Ductus perilymphaticus, des Spatium sacculare, der Pars communicans des letzteren, des Spatium naviculare, des Recessus fenestrae ovalis etc. im Gehörorgan von *Polypedates buergeri* Schlegel.   T. Ogawa.

448. Über die Macula acustica neglecta der Amphibien, der Säugetiere und des Menschen. Hideo SHIOBARA. [Hokuetsu Igk. Z., Niigata, **51**(1936), 1038-1053.] — Verfasser studierte die Macula neglecta in *Polypedates buergeri* Schlegel, *Pseudosalamander kimurai* *Vesperugo abramus*, *Sus scrofa*, *Mus musculus* var. *alba*, *Homo sapiens*, zum Teil nach Rekonstruktion der Plattenmodellen. Die Macula neglecta der Amphibien entspricht strukturell nicht der Crista sondern der Macula acustica. In Embryonen von *Mus musculus* var. *alba* sind die Macula neglecta Sarasini und Macula neglecta Retzii co-existent. Die Macula neglecta der Säugetiere differenziert sich, wie bei Amphibien, aus der Macula partis inferioris.   T. Ogawa.

449. Mikrochemie des Lipoides in den Leukozyten. (Japanisch.) Yasuhiko HAMAI. [Mitt. med. Akad. Kyoto, 17(1936), 596-614, 668, 1 Taf.] — Untersucht wurden die Leukozyten der Leiche, des gesunden Menschen und der Tiere (Kaninchen, Meerschweinchen, Ratte, Hund, Taube, Huhn, Frosche und Kröte.) In den polynukleären granulierten Leukozyten ist im normalen

Zustande reichliches Lipoid mit Sudan III nachweisbar. Das Lipoid nimmt seinen Sitz in den Granula und ist wenig widerstandfähig gegen den Aether und besonders gegen die Säuren (pH über 2,2.) Es lässt sich nur mit Sudan III färben und besitzt keine doppelbrechende Eigenschaft. Der Verfasser nimmt an, dass das Lipoid zum ungesättigten Phosphatide gehöre und mit der Substanz identisch sei, welche die Oxydase- und Peroxydasereaktion aufweist.   T. Fujita.

450. Über die Struktur der Samenfäden einigen Urodelen. (Japanisch.) Katsumi MORI. [Nagasaki Igk. Z., 14(1936), 125–132 mit 1 Taf.] — Die Samenfäden des *Hynobius nebulosus*, der *Pseudosalamandra kimurai*, des *Megalobatrachus japonicus* und des *Diemyctylus pyrhogaster* wurden mit verschiedenen Färbemethoden und auch an Querschnitten strukturell untersuchtt.   Nebenbei wurde die Länge der einzelnen Abschnitte der Samenfäden statistisch gemessen.   T. Fujita.

451. Studies on the Morphological Distribution of Glycogen in the Egg and the Tadpole of Frog. II. Report. The Stage from the Yolk Nutrition to the Oral Feeding. (Japanese.) Shimpei MIYAJIMA. [Seiikai Z., 55(1936), 1185–1206. 16 Tab. 1 Pl.] — The glycogen was found chiefly in white substance of the brain and the spinal cord, heart muscles, epithelial cells of the gastrointestinal tube, liver, pronephros or head kidney, epidermis, sucker or cement organ, optic cup, cartilage cells and skeletal muscles. The glycogen came to appearance generally as fine granules or droplets. It was, however, distributed quite diffusely in the pharyngeal region, the inner gills, and the sucker. There was no marked difference in glycogen content between the organisms in the stages of yolk and oral nutrition. The distribution pattern of the glycogen in tadpoles was almost coincident with that of mature frogs.   T. Fujita.

452. Studies on the Morphological Distribution of Glycogen in the Egg and the Tadpole of Frog. III. Report. The Stage of Metamorphosis. (Japanese.) Shimpei MIYA-JIMA. [Seiikai Z., 55(1936), 1576–1600, 16 tab. and 2 pl.] — The distribution of glycogen was almost the same as that in the tadpole. It seams therefore that the distribution of glycogen is little influenced by the metamorphosis or becoming carnivorous. The glycogen is mainly consumed for the formative activity in the stage of tadpole and for the formative and functional use in the later stages.   T. Fujita.

453. Untersuchungen über die Wachstumsgeschwindigkeit der Schneidezahne des Kaninchens. (Japanisch.) Tadayosi NISIZUKA. [Nihon Shika Gk. Z., 29 (1936), 533–540, 3 Tab. 1 Taf.] — Die Schneidezähne des Kaninchens wachsen schneller bei der Resektion der Antagonisten. Die unteren Schneidezähne wuchsen nämlich 12,3 mm in 25 Tagen (ca. 2 mal so viel als im normalen Zustand) und die oberen 8,70 mm in 15 Tagen (ca 1,5 mal des normalen Wachstums).   T. Fujita.

454. Untersuchungen über das Blut der Giraffe. (Japanisch.) Takaatu TAKAHASI, Raiziro TAKAHASI u. Naniti YAMAMOTO. [Rikugun Jûi. Hô, 318 (1936), 1–23, 5 Tab.] — I) Rote Blutzellen: abgeplattet oval (2,8 bis 3.5 μ, 5,6 bis 6,3 μ), 9–13,7 Millionen bei Männchen und 6–9,28 Millionen bei Weibchen. Senkungsgeschwindigkeit sehr klein. II) Weisse Blutzellen: normalerweise 1 auf 50 Erythrozyten, neutrophile polynukleäre Leukozyten 60%, Lymphozyten 37,67%, eosinophile Leukozyten 1,5% und grosse Monozyten samt Übergangsformen 1,34%. III) Widerstand der Erythrozyten. IV) Gesamte Blutmenge. V) Menge des Blutfarbstoffes. VI) Spezifisches Gewicht. VII) pH. IX) Osmotischer Druck. X) Chemische Bestandteile. XI) Vergleichung mit dem Blute der anderen Ungulaten.   T. Fujita.

455. Ein Fall des Zahnmangels in der unteren Schneidezahngebiet nebst der erblichen Belastung für denselben. (Japanisch.) Yosiatu TOYOSIMA. [Nihon Shika Gk. Z., 29 (1936), 584–590, 4 Taf.] — An dem Unterkiefer eines 23 jährigen Mannes wurde das Fehlen der beiden mittleren Schneidezähne aufgefunden. An Stelle der fehlenden Zähne blieben die Milchschneidezähne stehen. Durch die Untersuchung der familiären Verhältnisse wurde festgestellt, dass die ähnliche Anomalie bei der Mutter und dem Bruder des Patienten vorhanden ist.   T. Fujita.

456. On the lobus electricus and the nervi electrici in *Narke japonica*. Naokichi SUZUKI. [Manshû Ig. Z., 25(1936), 1–12, 15 figs.] — The anastomosis of the axis-cylinder process or the interneuronal connection of the ganglion cells can well be observed in the lobus electricus of *Narke japonica*. The ganglion cells have not only the fibrilar appearance in their ground substance, but also the granular element may concentrally distributed around the nucleus, except the hillock of the axis-cylinder process. The nervi electrici which issue on the ventral side of the lobus electricus consist chiefly of bour fundles. The branches of the first electric nerve run laterally to the nucleus trigeminus mot. ant. passing through the nucl. facialis sens., being mixed with the fibres of the tractus cerebello-motorius cruciatus. The other branch separated from the second electric nerve run ventromedially. One part of this bundle reaches the nucl. glossophar. et vagus, while the other enters the fasciculus longit. post., passing through the above mentioned nucleus. The scattered fibres which emerge from the posterior half area of the lobus electricus run ventromedially and pass along the dorsomedial rand of the fasc. longit. post. and intersect with the controlateral fibres in the raphe.   T. Fujita.

457. Über den Bau und die jahreszyklischen Veränderungen der Brunstschwiele bei der japanischen Kröte (*Bufo formosus*). (Japanisch.) Minoru NAKASHIMA. [Kaibô. Z., 8 (1936), 1177–1209.] — Die Brunstschwiele von *B. f.* kommt am 1–4 Finger konstant vor und besteht aus vielen „Schwielenkegelchen", eigentümlichen Verdickungen der Epidermis, deren Oberfläche mit zahlreichen „Widerhäcken" versehen ist. An der Epidermis wird 2 Schichten unterschieden: hypertrophierte Epidermisschicht und spezifische Hornschicht. Die „Häckenzelle" weist anfangs eine kubische Form auf, wandelt sich später durch Apposition der Hornsubstanz von der unterliegenden Epidermisschicht zum eigentümlichen „Widerhäkchen" um. Die Schwiele zeigt am Ende März oder am Anfang April die höchste Entfaltung, im Frühsommer die schwächste Entwicklung. Die Regeneration beginnt schon im Spätsommer und geht in der Winterschlafzeit lebhaft vor sich.   S. Nishi.

458. Ein Junges Menschenei (Ei-Andô). Keiichi HIRAMATSU. [Fol. Anat. Jap., 16 (1936), 15–45, 7 Taf.] — Das erste in Japan gefundenen jüngste Menschenei, dessen Alter vermutlich 14–15 Tage beträgt. In der Embryonalanlage sind die Ekto- und die Entodermblase unterscheidbar; der Embryonalschild mit einer Grösse von 0.24 : 0.26 : 0.04 mm bildet noch nicht den Primitivstreifen und die -rinne, die Entodermblase noch die Allantoisbucht. Hinsichtlich der Herkunft der Syncytiumzellen nimmt Verf. ihre Abstammung von Cytotrophoblasten an; Der Verschlusspflopf ist nicht die Gerinnungsmasse sondern die nekrotisierte Masse der zum Verschluss der Eingangspforte hyperplasierten primären Decidua capsularis.   S. Nishi.

459. On the Behaviour of Catfish in Response to Galvanic Stimuli. Seiji KOKUBO. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, Nos. 2 & 3, (1934), 87–96. 2 figs.]

460. The Duration of Life of Earthworms in Water and in Pure Gases. Tametake NAGANO. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, Nos. 2 & 3 (1934), 97–109. 4 figs.] — The author aims to find the cause of death of earthworms that are found dead on the ground especially frequently after rains. The experiments were carried out with tap water, distilled water, humus extracts, pure nitrogen and carbon dioxide of various concentrations dissolved in the mediums just mentioned. The pH of the medium was also determined in the latter case. The earthworms can live for months in the glass vessels circulated with running tap water. The viability of the animal varies with the species. The duration of life in pure nitrogen and carbon dioxide was determined. The lack of oxygen and excess of carbon dioxide seem to be responsible for the death of the animal; that is, osmotic and other relations are not emphasized, as often are according to other authors.   S. Nomura.

461. On the Ganglion Cells in the Heart of the Pearl Oyster: *Pinctada Martensi* Dunker. Senji SUZUKI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), 9, Nos. 2 & 3 (1934), 111–115. 3 figs.] — The author previously described the distribution of ganglion cells in the heart of the oyster (the same journal, vol. 8, no. 4), and in this paper he also reports similar results of the study. The gross anatomy of the pericardium, the visceral ganglia and the heart of *Pinctada matensi* is given. A branch of the cerebrovisceral connectives, originating near the

visceral ganglia, runs towards the pericardium and innervates the visceral mass after passing the base of the auricles. But, penetrations of these nerve fibres into the heart could not be demonstrated in examing the serial sections. All the heart muscles are non-striped. The existence and distribution of ganglion cells in the heart were described. Nerve fibres in the auricles were observed by vital staining. The histological feature of these nerve fibres was almost the same as that of the common oyster. S. Nomura.

462. On the Innervation of the Heart of Limpets. Senji SUZUKI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), **9**, Nos. 2 & 3 (1934), 117–121. 2 figs.] — The visceral ganglion consists of nerve fibres and ganglion cell which are unipolar or bipolar. The heart consists of three parts: auricle, ventricle and intra-pericardial aortic bulb. The heart is innervated by two branches of the visceral nerve, one of which enters the auricle and is distributed to both the auricle and the ventricle, while the other enters the aortic bulb and innervates the aortic bulb, aorta and the ventricle. The existence of ganglion cells in the heart was ascertained and their distribution was examined. Ganglion cells are more abundant in the other parts of the heart. S. Nomura.

463. Über die Exogastrulabildung beim Seeigelkeim durch Auxin, Glykogen und KClO₃. Isao MOTOMURA. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), **9**, 2 & 3 (1934), 123-130. 4 Figs.] -- The effect of auxin, glycogen, glucose and $KClO_3$ on the fertilized eggs of *Strongylocentrotus pulcherrimus* was studied. Auxin solutions produced exogastrula, while glycogen solutions mostly produced exoentogastrula. Exogastrulation can also be caused by addition of $KClO_3$ to Herbst's artificial sea water. Glucose has no such an effect. S. Nomura.

464. Ganglion Cells in the Heart of *Ligia exotica* (Roux). Senji SUZUKI. [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), **9**, Nos. 2 & 3 (1934), 213–217. 4 Figs.] — The gross anatomy of the abdominal ganglion and the heart is given. A nerve fibre bundle which runs along the dorso-median line of the heart contains six ganglion cells. These are multipolar. Two pairs of nerve fibres enter the heart on the mid-dorsal wall of the heart. The first pair of them contains two nerve cells near the heart. while the second pair contains only one cell in each fibre. S. Nomura.

465. Report on the Fresh-Water Sponges Obtained from Hokkaido. Nobuo SASA-KI [Sci. Rep. Tôhoku Imp. Univ., Ser. IV (Biol.), **9**, Nos. 2 & 3 (1934), 219–247. 4 pls. & 15 figs.] — The author describes eight species of fresh-water sponges collected in his trip to Hokkaido in 1933. Two of the species are new. The list of species runs as follows: — 1. *Spongilla lacustris* (Linné). 2. *Spongilla shikaribensis*, n. sp. 3. *Spongilla fragilis* Leidy. 4. *Spongilla akanensis*, n. sp. 5. *Ephydatia fluviatilis* (Linné). 6. *Ephydatia mülleri* (Lieberkühn). 7. *Epydatia mülleri* var. *japonica* (Hilgendorf). 8. *Heteromeyenia baileyi* var. *petri* (Lauterborn). S. Nomura.